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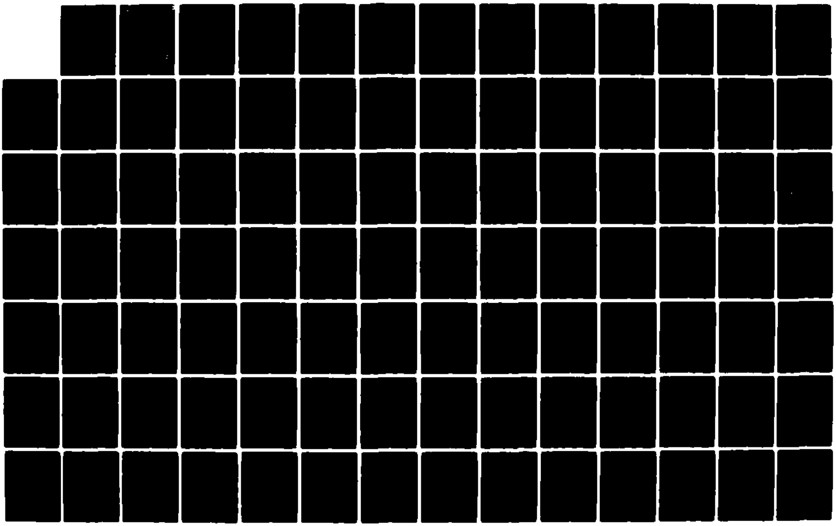

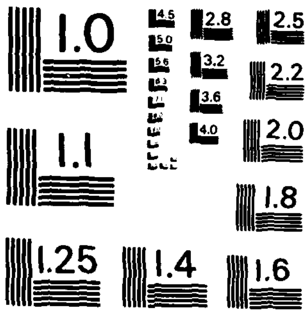

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AD-A132 615

FINAL REPORT

FOR THE

SOIL AND VEGETATION PROJECT

A Detailed Study of Five Overburden Cores and Six Disposal Areas Along the Divide Section - Tennessee - Tombigbee Waterway

John T. Ammons, Paul A. Shelton and Glenn G. Davis

Plant and Soil Science Department
School of Agriculture
Tennessee Technological University
Cookeville, Tennessee

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Overburden, disposal area soils and vegetation were evaluated in the Divide Section of the Tennessee-Tombigbee Waterway. Acid-Base Accounting was completed of five overburden cores revealing which strata are potentially toxic to plant growth to control erosion. Disposal area soils are characterized both chemically and physically establishing the property base of these soils. Vegetation evaluations are drawn from line transects and demonstration plot studies with emphasis on plant ecology considerations.

Results indicate that nutrient are generally not a problem. Major concern

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17 June 1983

U.S. Army Corps of Engineers
Nashville District
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The following people participated in the preparation of this report: John T. Ammons, Glenn G. Davis and Paul A. Shelton.

Assistants in the field and laboratory work included: Douglas Clendenon, Randy Dodson, John Edwards, Charles Frase, Nathan Hartgrove, David McMillen and Marjorie Stevenson.

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ABSTRACT

Overburden, disposal area soils and vegetation were evaluated in the Divide Section of the Tennessee Tombigbee Waterway. Acid-Base Accounting was completed on five overburden cores revealing which strata are potentially toxic to plant growth to control erosion. Disposal area soils are characterized both chemically and physically establishing the property base of these soils. Vegetation evaluations are drawn from line transects and demonstration plot studies with emphasis on plant ecology considerations.

Results indicate that nutrient deficiencies are generally not a problem. Major concern is directed toward avoiding placement of pyritic material on the surface of disposal areas and properly evaluating and correcting liming needs.

CONCLUSIONS

CONCLUSIONS

1. Overburden analysis with Acid-Base Accounting completed on all deep earth excavations, will enable the analyst to evaluate the potential acidity and potential basicity of overburden materials before excavation. Acid-Base Accounting, a method used widely to characterize overburden in surface mining, is a reliable index of excess bases or potentially toxic materials and can be used to guide selective placement of these materials to insure a quality environment. Selective placement of overburden during excavation phases of construction is more economical than post - construction additions of amendments.

2. An "auto-fertilizing" phenomenom with the nutrient elements potassium, phosphorus and magnesium is evident from the data on the disposal areas constructed from typical Eutaw beds. With double-acid extractions for potassium and magnesium and sodium bicarbonate extraction of phosphorus, values exceed requirements to sustain vigorous vegetation. Adequate neutralizers applied according to Acid-Base Accounting data coupled with additions of nitrogen and adequate mulch will establish vegetation for erosion control

3. The double acid extractable phosphorus procedure proved unreliable for testing materials originating in a reduced environment. For this reason, this phosphorus test was discontinued due to the interferences from ferrous iron and possibly other elements. The sodium bicarbonate extractable phosphorus method is more suitable for these materials.

4. With overburden materials suspected of being potentially acid, at least three laboratory measurements should be made: (1) paste pH; (2) total or pyritic sulfur and (3) neutralization potential.

5. Based on common agricultural practices, additions of adequate neutralizers on acid soils will enhance establishment of legumes if lime is applied well in advance of final seeding and fertilizing. This allows the lime time to conteract acidity and precipitate soluble iron.

6. The presence of aluminum sulfate minerals on the surface of disposal areas directs attention to the presence of pyrite. These minerals have a "bitter metallic" taste and should not be confused with gypsum, a non-acid calcium sulfate mineral, which does not have the "bitter metallic taste". Aluminum sulfate mineral formation will decrease with liming but calcium sulfate minerals will increase with liming. The presence of these minerals are temporary in humid regions with adequate rainfall as long as soil drainage is not restricted.

7. Disposal area data indicates that excess neutralizers in the surface layer sustained vegetation. Partial oxidation of pyritic materials plus additions of lime reduce oxidation rates allowing plants to become established. Ideally, incorporation of adequate neutralizers to eight inches with the immediate surface limed properly allow seeds to germinate and plants to persist. If extreme acidity is prevalent on the surface, high concentrations of mobile aluminum will cause immediate seedling mortality.

8. Based on soil profile descriptions and field observations on most disposal areas, root penetration is generally inhibited by acid-toxic zones in the soil and not by high bulk densities. Bulk densities of 1.6 to 1.8 g/cm^3 are reported here in the data which may limit root

proliferation, but no continuous layers of excessively dense soil occur in the disposal areas observed. Physical variability in the soil profiles allows roots to penetrate deeply into the soil profile unless acid-toxic condition prevail and prevent penetration.

9. Micronutrient deficiencies at present are not a problem in the disposal areas, but sandy soils often develop micronutrient deficiencies over time. Zinc and copper are elements most likely to become deficient over time according to the values reported in the data on the disposal areas, but severe deficiencies seem unlikely.

10. Metallic element toxicities are common on extremely acid soils, especially iron, aluminum and manganese. Liming such soils to eliminate extreme acidity will immobilize these elements and reduce their activity below toxic limits.

11. Concentrations of potassium chloride extractable aluminum greatly increase below pH 4.0 Root penetration is inhibited where aluminum levels are high and pH values are extremely low (<4.0). Aluminum present in high concentrations on the surface inhibits seed germination and plant establishment. Liming to balance the Acid-Base Account decreases concentrations of aluminum as evidenced by the data reported on disposal areas. Moreover, high calcium levels from liming allow plants to thrive at higher concentrations of soluble aluminum than where calcium levels are low.

12. Laboratory measurements of soil moisture retention do not reflect field moisture regimes precisely. Soil profile morphological descriptions in the disposal areas indicate contrasting textures in layers of varying thickness which affect profile drainage and plant available moisture. More low-tension (plant available) moisture is retained due to the discontinuities in the soil profiles.

13. Acid-Base accounting data from disposal areas show that potentially toxic soil materials are commonly present in the second sampling depth. Deep plowing will initiate a pyrite oxidation cycle causing plant mortality and erosion. Therefore, additional deep plowing should be avoided. Moreover, in this climate downward leaching of lime will tend to counteract slow release of sulfate acidity and will remove salts to deeper and safer depths.

14. If vegetation dies in spots (locally) after the initial stand establishment, spot treatments with lime and other nutrients, based on laboratory tests, should be followed. Particular attention to quick renewal of vegetation on sloping areas is essential in order to prevent formation of gullies in these highly-erodible soils.

15. Oxidation of pyritic materials originating from the typical Eutaw beds begins immediately once they are placed on the surface of disposal areas. Sandy materials containing pyrite with low levels of bases to counteract acidity produced allow a rapid rate of acid formation. Adequate neutralizers added to these pyritic materials counterbalance acidity being produced and maintain pH levels high enough to substantially diminish the role of microorganisms in the oxidation cycle.

16. Disposal area soils can be classified by observable or easily measureable properties and interpreted for future land use and management. Identification of map units in a proposed classification system by taxonomic class enhances long range planning maintenance of disposal areas.

17. Conventional "lime requirement" methods are not designed to evaluate potential acidity of pyritic soils or unreacted carbonates that may constitute important reserves of neutralizers.

18. Vegetation failed to establish and persist on the disposal areas most often because of inadequate amounts of lime. Newly germinated plants of legumes and grasses require neutralizers in their root environment in order to emerge and establish. Vegetation decline that occurs after stands of plants are established can be halted or reversed by applications of several tons of lime over the top of the vegetation. Repeated applications probably will be required to sustain vigorous plant growth.

19. There is no indication from soil analyses or seed germination tests that soil salinity inhibits seed germination or seedlings establishment on soils of the disposal areas.

20. Plant succession patterns that are similar to old field succession patterns in the southeastern United States have begun to develop on some disposal areas on the project. On DA 1503 more than 20 species of herbaceous plants were present in 1982. This is a fourfold increase over the original number of seeded species. The field was in the early annual broadleaf stage of succession. On DA 1503 a perennial legume, sericea lespedeza was observed to have spread by seed from one parent plant. Sericea lespedeza has replaced weeping lovegrass as the dominant species in one section of DA 1704. Burning on DA 1704 and DA 501 in preparation for tree transplanting reverted part of each area from the early perennial stage to the annual broadleaf stage of succession. In parts of these two areas sericea lespedeza spread following burning.

21. Two disposal areas that have been seeded less than two years, DA 1203 and DA 1204, were dominated by the seeded species. Annual grasses invaded some open niches in these fields. Continued observation of the shifts in vegetative cover in these six disposal areas should

provide valuable information on which management decisions could be based for disposal areas under construction.

22. Vegetation cover disappeared rapidly in disposal areas where liming was not repeated when soil pH fell below 4.0. Vegetation recuperated its vigor and new species invaded when lime was applied to areas showing plant stress from low pH. In areas where erosion followed decline, revegetation was required. Strips and patches of vegetation often remain in sections of areas with declining vegetation and erosion. These sections with living plants will stabilize if left undisturbed and limed when the area is reseeded. Disposal area soil that is exposed or inverted by discing is much more toxic and requires more neutralizers for plant growth than undisturbed soil. Older plants are more tolerant to aluminum in the rhizosphere than are seedlings. The surviving sections with surviving plants might be salvaged and revived by liming and overseeding.

23. When nitrogen fertilizer is applied to areas vegetated with legumes and grasses, the grasses become dominant over the legumes. If management goals are to sustain a pure stand of bermudagrass, N should be applied twice per year at a rate of 200 to 300 pounds of N/acre/year. When N is applied to mixed legume-grass swards, N fixation is reduced in the legume in proportion to the N fertilizer applied. The grass becomes more competitive with the legume and the legume becomes less vigorous and less abundant. In new seeding and reseeding where vegetation failed, N rate should be limited to approximately 20 pounds/acre if a mixed plant composition including legumes is desired.

24. All legume seed must be treated with the strain of rhizobia that is specific for the legume genus. Inoculum viability deteriorates

rapidly after the seeds are inoculated (see Appendix H). Viability declines more rapidly when the inoculated seed are stored at 70°F than at 60 or 40°F. Seed should be inoculated in the field immediately before they are placed in the seeder.

25. The depth of root penetration of first year plants in disposal area soils is generally limited to the depth of lime placement. Root penetration to 8 to 12 inches is generally estimated adequate to sustain vigorous growth in the humid, temperature climate zone where the waterway is located. Lime must be present at the surface of the soil in order for radicles to penetrate the soil. The depth and uniformity of lime incorporation by various field implements can be determined by incorporating dyes with the implements. Alternately, a visual test for free carbonates in the soil profile can be conducted by applying drops of 10% HCl to each depth zone (fizz test).

RECOMMENDATIONS

RECOMMENDATIONS

I. <u>Selective Placement of Overburden Materials for Construction of New Disposal Areas</u>.

Purpose of Selective Placement:

1. Economic efficiency.
2. Simplification of treatments and practices for revegetation.
3. To assure consistent success of revegetation procedures without repeated treatments and seedings; moreover, to assure high quality permanent stands of vegetation.

Identification of overburden materials is important in selecting which materials are best for plant growth. For this reason, a grouping and identification of the overburden material is present as a guide to selective placement.

The overburden is divided into two broad groups: (1) Low chroma materials (grays and blacks) encompassing chromas from 0-3 on dry 60-mesh samples read with a Munsell Soil Color chart (the term "low-chroma" is used by the USDA-SCS as chroma 2 or less); and (2) High chromas (browns, yellows and red colors) that read greater than chroma 3 on dry 60-mesh samples with a Munsell Soil Color chart.

<u>Low Chroma Overburden</u> (Chromas 0-3)

The low chroma overburden is divided into two groups: (a) Alluvial materials that contain non-lithified wood, leaves, nuts and bark of modern trees. This material can be used as a plant growth medium if selectively placed on the surface; (b) Low chroma overburden (Lower Eutaw)

that contains lenses of non-lithified sand and fine mudstone interlayered with thin, sandy, partially-lithified sandstone and shales with visible pyrite, and lithified wood, some containing pyrite. This section also contains infrequent zones of high carbon material (carbolithic) with visible pyrite present. Where low chroma or carbolithic material is confirmed to contain pyrite either by taste, smell, visual observation or laboratory analysis, avoid placement on the surface or in the root zone.

Although zones of lower sulfur and slightly higher calcium carbonate equivalence occur in some cases in the Lower Eutaw, field confirmation and selective placement may be difficult to make from the Lower Eutaw.

<u>High Chroma Overburden</u> (Chromas greater than 3)

The high chroma overburden materials are found in the upper portion of the geologic section and include the native soil, yellow or brown sands and reddish yellow sands and loamy sands (upper portion of alluvium). This material is free from pyrite and is suitable for plant growth medium on new disposal areas.

<u>Excavation of Overburden</u>

The overburden should be excavated in accordance with properties as follows:

1. All high chroma materials of significant thickness should be removed separately from low chroma materials and disposed of either: a) as "plating" on essentially completed cuts or disposal fill sites; or b) in temporary storage deposits for later use as "plating" when needed.

Approximately twelve inches of high chroma material should be used as topping on completed cuts or disposal areas. Materials dominantly

sand or loamy sand should be limed at a four ton per acre rate and lime incorporated eight inches. Materials of medium to fine texture (sandy clay loam, sandy loam and clay loam) should be limed at a six to eight ton per acre rate incorporated to eight inches. Tennessee Technological University soil laboratory data should be consulted to monitor the quality of all "plating" materials.

2. All low chroma alluvial material (low chroma a) if needed for plating should be excavated separately from Lower Eutaw material (low chroma b) and should be placed immediately on cuts or fills that are ready; or in temporary stockpiles from which suitable plating may be obtained whenever needed. This material should be limed at a four ton per acre rate and the lime incorporated to eight inches.

3. All low chroma Lower Eutaw material low chroma b) should not be placed at or near the surface. This material shows visible pyrite at various depths and has been confirmed in the laboratory to contain significant concentrations of pyritic sulfur which will cause vegetation failures when the oxidization of pyrite generates extreme acidity.

The total quantity of satisfactory "plating" material in the area to be excavated is estimated to be adequate for all needs. It is comparatively easy to recognize by most field personnel. The layers to be removed for immediate placement or for storage and later use are thick enough for efficient excavation and handling without disruption of operations.

The degree of selective excavation based on readily recognizable properties, as described, requires little planning but could prevent most of the troubles experienced in connection with reclamation.

II. Recommendations for Spot Treatment Where Low Chroma Lower Eutaw (Low Chroma B) Was Placed on the Surface of Disposal Areas

Existing disposal areas that show dead vegetation with "wet" or "oily" appearance in relation to the surrounding dry soil; low chroma sandy nodules with visible pyrite; carbolithic materials (carbon) and lithified wood should be identified for immediate treatment. These properties can be determined in the field by the previously mentioned visual observations or by the bitter metallic taste and metallic smell.

Priority of treatment should go to those disposal areas where the loss of vegetation promotes severe erosion. Twenty-five tons of lime should be incorporated to eight inches followed by three tons on the surface before planting. The area should be seeded with small grains and mulched at a three ton per acre rate. A three month delay will allow fine lime particles to react thus allowing successful establishment of permanent grass legume mixtures. Acid-base accounting at TTU soils lab should be completed on these materials and adjustments to liming rates made accordingly.

An alternative to the amelioration procedure previously discussed is "plating" the extremely acid soil on disposal areas. If pyrite-free material can be obtained at or near the site, it may be economically feasible to "plate" the disposal areas. Reduction in lime rates may offset handling costs of the "plating." All materials to be used for plating should be analyzed in the laboratory prior to their use in the field, to determine suitability for growth medium.

III. Recommendations for Disposal Areas with Permanent Vegetation

Permanent vegetation on disposal areas should be maintained to prevent erosion, especially on strongly sloping sections or long gently

sloping sections with no diversions to break the length of slope. Erosional cuts may expose pyritic materials that will initiate the oxidation cycle thus contributing to continuing loss of vegetation by release of acid. For this reason, it is recommended that disposal areas not be "burned" off to plant trees.

Certain herbaceous plantings may interfere or inhibit the establishment of trees. An alternative method would be to use various recommended herbicides to reduce the vegetation in contour strips and then plant the trees in these strips. Vegetation can be maintained to protect soil from erosion and mulch will protect soil in the treated contour strips.

Interplanting or overseeding of black locust with hardwood species already being planted on disposal areas may increase survival rate of the tree plantings. Black locust has a good survival rate on acid soils and is used widely by reclamation specialists in the coal surface mining industry.

IV. Acid-Base Accounting

Acid-Base Accounting should be used to evaluate liming needs on samples suspected of being acid-toxic. Conventional lime requirement methods do not access liming needs on soils containing pyritic materials.

V. Nitrogen

Top-dressing with high rates of nitrogen will decrease chances of establishing legumes. The establishment of grass-legume mixture to sustain vegetative cover is imperative. Therefore, it is recommended that close observations of grass-legume mixtures on disposal areas guide topdressing with nitrogen.

VI. Classification

Soil classification and mapping of the disposal areas will aid in long range planning, management and land use. For this reason, it is recommended that the disposal areas in the divide section be mapped according to properties and divided into land use suitability classes.

VII. Fertilization

Maintenance fertilizer rates should be adjusted to soil test data and to plant species desired for each specified disposal area.

VIII. Seeding Mixes for Original Seeding and Reseeding[1]

The seeding mix should be selected according to the planting season involved. Sericea lespedeza should be included in each mix or sericea should be overseeded in April on any field seeded from September 1 to March 1. Crimson clover or red clover should be included in fall seedings. Examples of seeding mixes that are appropriate for the various seeding times are listed below:

Season of Seeding	Seeding Mix
September 1 to November 1	Tall fescue, crimson clover, and sericea lespedeza in the mix or overseed sericea in April.
February 1 to March 15	Tall fescue and sericea lespedeza or overseed sericea in the fescue after April 1.
March 15 to August 31	Bahiagrass, weeping lovegrass and sericea lespedeza or Bermudagrass and sericea lespedeza.

[1]Recommendations are based on observation made in disposal area sites for the brief span of this project and on information gained from many diverse sources and extrapolated to the conditions of the disposal sites.

Bermudagrass fields should be overseeded in the fall with crimson or red clover. Crimson clover will not establish and produce seed if planted after the winter solstice. It is not tolerant to heat. Weeping lovegrass should never be the only grass species included in a seeding mix. This species is a "bunchgrasss" in growth habit. It will form isolated stools after its first year of growth. Erosion often begins in the bare soil between stools of weeping lovegrass.

Legume seed must be inoculated with the specific strain of Rhizobium species bacteria to produce nodulation.

IX. Soil Preparation, Liming, and Seeding

Original seeding of a disposal area should include the following general practices: lime application in the amount indicated by acid-base accounting; incorporation to a depth of eight inches, and application of three tons of lime on the soil surface. Following seeding a cultipacker should be passed over the field. Distribute 3 to 4 tons/acre of mulch depending on slope and crimp the mulch.

For revegetation of disposal area or section of an area where vegetation failed, the least amount of soil disturbance possible is recommended. If strips of 40 feet width or more of vegetation exist between bare areas, approximately 6 ton/acre of lime should be applied over the vegetation without discing or inverting the soil in the vegetated spots. If legumes make up less than 25 percent of the plants in the vegetated spots, sericea lespedeza should be overseeded in the grass vegetation from April to September. Crimson or red clover should be seeded over the vegetated spots if the area is reseeded in September - November.

X. Fertilizer for Seeding and Reseeding

A laboratory test for P and K should be done before these nutrient elements are applied. If P and/or K are deficient the amount determined by soil test should be applied at liming and be incorporated with the lime. In overseeded spots, P and K should be applied on the soil surface in the same way as lime is applied.

If a plant composition made up of a mixture of grass-legume is desired, N application at seeding or reseeding should not exceed 20 pounds per acre. Nitrogen should not be applied to fields in which the plant composition is more than 10 percent legumes. Nitrogen applied to a grass-legume mixed sward stimulates growth of the grass more than it stimulates growth of the legume. Consequently, the percentage of grass in the stand will increase while the legume will decrease or disappear completely. If a pure stand of bermudagrass or other grasses is desired, apply N twice per year (200-300 lbs N/a/year).

XI. Seed Inoculation

Inoculate all legume seeds with the specific symbiotic strain of *Rhizobium japonicum* immediately before placing the seed in the seeder hopper. Use water, a sugar based solution, or any of several commercially available inoculant stickers and mix thoroughly to insure distribution of inoculum to all seeds. From pasture seeding experience and the data observed in the tests performed for this project it does not appear reasonable to plant seed that has been inoculated for a period of more than 12 hours if seed temperature is above 70°F. Do not plant legume seeds that have been inoculated for more than 72 hours if seed storage temperature is above 40°F.

XII. Vegetation Suppression for Tree Planting

A desiccant type herbicide is widely used to suppress grass growth for pasture renovation. It could be used in place of burning to suppress herbaceous vegetation in preparation for transplanting seedlings of woody species on disposal areas. The herbicide compound paraquat is registered with EPA for use on noncrop and crop land. The compound is marketed commercially as Paraquat by Chevron and as Gramoxone by Imperial Chemical Company (ICI). A surfactant should be added to spray solution containing paraquat. Paraquat has no residual activity in soil. Paraquat is a restricted use compound. Always follow the instructions and safety procedures printed on the label of herbicides.

XIII. Plant Succession Pattern Studies

The vegetation on DA 1503 is in the first stage of plant succession. More than 20 herbaceous plant species were counted in the area in 1982. The composition of the plant population is predicted to become less diverse in the 1983 and 1984 growing seasons. An indication of what is to be expected to occur on other disposal areas on the project can be gained if the plant succession process on DA 1503 is catalogued for reference.

The vegetation status in 1982 of DA 1203 and DA 1204 are similar to the status in DA 1503 in 1981. DA 1704 has received management treatments that are different from those imposed on the three areas above. Information gained from a study of the plant succession patterns on DA 1503, DA 1203, DA 1204, and DA 1704 could provide valuable information that would influence vegetation management on these and other disposal areas on the project.

I N T R O D U C T I O N

INTRODUCTION

The U.S. Army Corps of Engineers have under construction a waterway connecting the Tennessee River with the Gulf of Mexico via the Tombigbee River. During construction of the divide section, accelerated erosion due to vegetation failure was noted in some disposal areas.

The Plant and Soil Science Department at Tennessee Technological University was contracted to study overburden, soils, and vegetation in selected disposal areas. Acid-base accounting was completed on overburden cores to identify acid-toxic zones and zones with adequate neutralizers to aid in reclamation of new disposal areas. Calcium, magnesium, potassium, paste pH and phosphorus measurements were completed on overburden cores to provide an indication of plant nutrient status in various strata of the geologic section.

Acid-base accounting, pH, calcium, magnesium, sodium, potassium, phosphorus, iron, zinc, copper, manganese, and KCl-extractable aluminum were completed on the disposal area samples, evaluating the chemical character of the new soils, with emphasis on problems related to pyrite-induced acidity and their correction as the focal point of this study.

Four conventional lime requirement methods were evaluated on selected samples from the disposal areas to establish usefulness of these tests in evaluating soils containing pyrite.

In addition to the chemical characterizations, bulk density, texture and moisture retention were completed on selected samples from the disposal areas.

Vegetation evaluations on both lime demonstration plots and disposal areas were completed. Growth chamber studies on acid soils were repeated twice using three species of plants in the seeding mixture commonly used on the waterway. Vegetation transects on six disposal areas revealed which species became established, and vegetation success was compared to soil testing data completed on these disposal areas. Plant ecology considerations were made from listing invading species in the transects.

The disposal areas selected for study include the following; 1503 and 1504, selected on the basis of dead or dying vegetation; 501 and 1704, selected on the basis of successful revegetation; 1203 and 1204, selected on the basis as newly constructed with change in liming rates.

Evaluation of the disposal areas plus the overburden analysis presents a cross-section of materials observed in the disposal areas. This information provides baseline soil property information to solve present and future problems that may develop resulting from vegetation failures.

M A T E R I A L S A N D M E T H O D S

MATERIALS AND METHODS

Field

Site Selection - Disposal Areas

Six disposal areas were selected for sampling along the Divide Section of the Tennessee Tombigbee Waterway. The sites were selected with input from Corps of Engineer personnel. Disposal areas sampled and rationale for sampling are as follows: DA 1504 (dead vegetation); DA 1503 (vegetation under stress); DA 1204 (recently deposited with variable soil amendments); DA 1203 (same as DA 1204); DA 1704 (good vegetative cover south end of the divide cut); DA 501 (good vegetative cover north end of divide cut). The sites selected gave an overall view of the property base of the disposal areas in the Divide Section of the waterway.

Site Selection - Overburden Cores

Overburden cores were acquired from the U.S. Army Corps of Engineer personnel for five core sites. These cores were selected from areas yet to be excavated in the Divide Section. Core numbers U894A, U895, U895A, U896, and U897 were sent to the Plant and Soil Science Department at Tennessee Technological University in Cookeville, Tennessee. Core locations were confirmed in the field and plotted by TTU and Corps of Engineers personnel (core location map in Appendix B).

Disposal Area Sampling

The six selected disposal areas were sampled using two to three depths depending on the morphologic breaks of the soil at the sampling

point. Sampling points were selected on the basis of the presence or absence of vegetation. Brief field notes were taken on each sample (see Appendix A, core and sample logs).

To complement the disposal area sampling, selected detailed soil profiles were excavated to a depth of forty inches (1C0 cm). The description consisted of parameters commonly used in standard native soil descriptions with additional notes added in the narrative (Soil Survey Staff, 1951).

The excavated exposure was divided into layers on the basis of change in texture, structure, color or type, and quantities of coarse fragments. The following information was then recorded for each layer: distinctness and topography of boundary, texture (field), structure, moist consistency, Munsell colors, and root numbers (Soil Survey Staff, 1951, 1975).

The profile properties were summarized to fit into a disturbed soil classification scheme (Sencindiver, 1977; Sencindiver, Ammons, and Delp, 1978).

Selected sampling of soil profiles for physical analysis was completed for bulk density and porosity. Subsamples weighing from 200 to 500 grams (fist size clod) were taken for bulk density and porosity determinations. Samples were also selected for texture and moisture retention from a broad range of disposal area samples.

Disposal Area Lime Demonstration Plots

Disposal area 1504 was selected for lime demonstration plots. Five rates of lime and various seeding mixtures were evaluated. In August, 1981, a plot of approximately 1.5 acre was prepared for planting. Lime rates were replicated four times with seeding mixtures (see field layout

diagram, page 22). Lime application was accomplished with a commercial spreader in a swath forty feet wide. Lime incorporation was with a disc-harrow cutting a minimum of four inches followed by a flat bottom breaker inverting the soil a minimum of eight inches. The breaking was followed with two discing-smoothing passes. The seeding was accomplished with a commercial hand seeder followed by cultipackers. Crimp mulching was used to reduce erosion.

Five lime rates calculated in tons/1,000 tons calcium carbonate equivalent were approximately four, eight, sixteen, thirty-two, and sixty-four tons per 1,000 tons material. Field lime rates were highly variable per plot and complete mixing from surface to depth of incorporation was variable. Seeding mixtures were as follows:

A. Weeping lovegrass, serecia lespedeza, and crimson clover.

B. Bahiagrass, serecia lespedeza, and crimson clover.

C. Bermudagrass, serecia lespedeza, and crimson clover.

D. Kentucky 31 fescue, serecia lespedeza, and crimson clover.

Seeding rates were as follows:

Kentucky 31 fescue . . . . 22 lb/A

Bermudagrass . . . . 15 lb/A

Serecia lespedeza. . . . . 25 lb/A

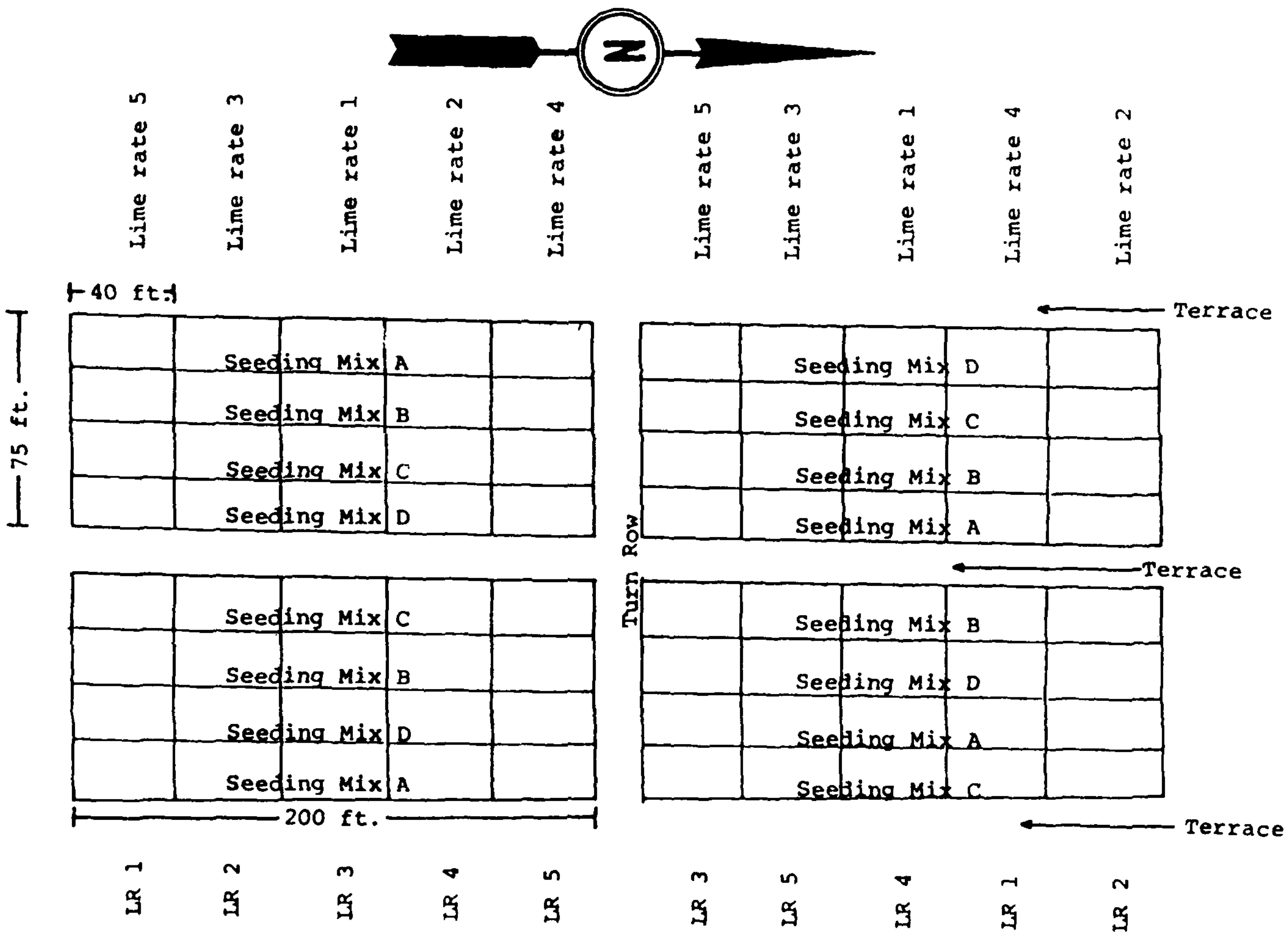
Crimson clover . . . . 5 lb/A

Weeping lovegrass. . . . . 3 lb/A

Bahiagrass . . . . 35 lb/A

Overburden Core Sampling

Five overburden cores were sampled by Corps personnel and sent to TTU via Atlanta (see core location map, Appendix B). Each core sample was logged and subsampled for analysis (see Appendix A - sampling logs).



Field Layout Diagram - Disposal Area 1504 Treated Plots

The drillers log was consulted for depths of the sample and general condition during sampling. The individual samples were identified as to lithology, color, texture by feel, checked for free carbonates, and other distinguishing characteristics of the sample.

Each core sample was split and half was put into storage (Sobek et al, 1978).

Soil Incorporation Indicator Dyes

On disposal area 1504, indicator dyes were tested to check depths of incorporation. Eight five foot by five foot plots were layed out and marked with stakes. Dye treatments were as follows:

Plot Number 1 - One pound of dye mixed with one and one half gallons of water poured on the surface (AN-15 Dupont Day-Glo Orange)

Plot Number 2 - One half pound of dye applied dry. Ground was preworked one-inch deep and then worked in after application.

Plot Number 3 - One pound of dye applied dry and worked in.

Plot Number 4 - One half pound of dye mixed with two gallons of water and sprayed on.

Plot Number 5A - One half pound of dye in two gallons of water sprayed on with 20-pounds of pressure.

Plot Number 5B - One half pound of dye in 2 gallons of water.

Plot Number 6 - One pound of dye applied dry.

Plot Number 7 - One fourth pound (purple dye) in one and one-half gallons poured on plots.

Plot Number 8 - One pound (purple dye) incorporated one inch.

Plot numbers 1,2,5,6,7, and 8 were disced. Plot number 3 and 4 were disced, broke deep, and disced again.

Evaluation of Vegetation on Disposal Areas

Evaluation of the various plant mixes was completed on disposal areas designated for soil investigations. A checkerboard-line cruise method was used traversing two different slopes. Interval counts were completed approximately every 100 feet. Initial observations on plant succession were noted after each transect was completed. A superficial check of root viability was also completed on selected species.

Laboratory

Sample Preparation - Core Samples

Subsamples from the individual cores were air dried and put through a grinder. The sample was then tumbled until thoroughly mixed. A subsample of approximately 100g was crushed with a mortar and pestle until all material passed a 0.25mm (60 mesh) sieve. This subsample was placed in plastic snap-top vials for acid-base accounting and nutrient status evaluation for cores in the laboratory. The remaining portion of the air-dried sample was stored (Sobek et al, 1978)

Sample Preparation - Disposal Areas

Air dry samples were crushed and passed through a 19mm sieve. (Selected coarse fragments greater than 19mm on the surface were sampled and processed for acid-base accounting). All material passing the sieve was crushed until less than 6.35mm.

The less than 6.35mm material was placed in a container and tumbled thoroughly until mixed. Approximately 100g was removed and ground to pass a .25mm (60 mesh) sieve for acid-base accounting. The remaining 6.35mm sample was used for chemical analysis, lime requirement studies, moisture retention studies, and texture.

CHEMICAL CHARACTERIZATION

pH (1:1 ratio)

Ten grams of sample was mixed with 10 ml of distilled water and allowed to equilibrate for an hour with occasional mixing. The samples were then read on a Fisher model 325 expanded scale pH meter which was calibrated with pH 7 and 4 buffers.

Lime Requirement Studies

Four lime requirement methods were evaluated on approximately ninety samples from disposal areas 1503, 1504, and other selected sites. The methods evaluated and compared were Woodruff's (Woodruff, 1948), SMP (Shoemaker, et al, 1962), Dunn's titration (Dunn, 1943), and Five Minute Boiling Method (Abruna and Vincente, 1955).

Woodruff's Buffer: A five gram sample (6.35mm) was weighed out into a paper cup. Five mls of distilled water were added and allowed to stand for one hour with occasional mixing. The pH of the soil plus water mixture was read on a calibrated pH meter (soil plus water mixture exceeding 6.5 had a lime requirement of zero). To this mixture, 5 mls of Woodruff Stock Solution was added and stirred periodically for thirty minutes. The pH meter was then calibrated to pH 7.0 with Woodruff buffer solution. The sample was read on the pH meter and recorded as the buffered reading. Lime requirement (in tons/1,000 tons material) was determined by subtracting the buffered pH reading from 7.0 and multiplying by 5.

SMP Buffer: A five gram sample was weighed out into a paper cup. Five mls of distilled water were added, mixed for five seconds, and pH was measured after five minutes. Ten mls of SMP buffer solution were added to soils having a pH of 6.5 or less and stirred for ten minutes.

The pH was determined after 30 minutes to the nearest 0.1 pH unit. Lime requirement was determined from a published table (Sobek et al, 1978; Shoemaker et al, 1962).

Dunn's Lime Requirement ($Ca(OH)_2$ Titration): Ten gram samples (6.35mm) were weighed into seven 250 ml Erlenmeyer flasks. Various increments of 0.04N $Ca(OH)_2$ representing 0.5, 1, 2, 3, 4, 5, and 6 tons calcium carbonate equivalent per 1,000 tons material were added to each flask. Each flask was then diluted with 100 ml of distilled water. Three drops of chloroform were added to each flask to prevent microbial activity. The suspensions were allowed to stand for four days with thorough shaking twice a day. Lime requirements (to pH 6.5) were determined on the suspensions at the end of four days by measuring pH and plotting against the levels of treatment (Dunn, 1943).

Five Minute Boiling Method: Ten grams of sample (6.3mm) were weighed into seven 250ml Erlenmeyer flasks. Added to each flask were various increments of 0.04N $Ca(OH)_2$ representing 0.5, 1, 2, 3, 4, 5, and 6 tons calcium carbonate equivalent per 1,000 tons material. Each flask was then diluted with 50 mls of distilled water and boiled on a hot plate for five minutes (intermittent stirring of samples may be necessary to avoid excessive foaming). The suspensions were cooled to 25°C and pH was determined. Lime requirement (to pH 6.5) was determined on the suspension by plotting pH against the levels of treatment (Abruna and Vicente, 1955).

Acid-Base Account

"Acid-base accounting is a dependable criterion by which overburden materials can be evaluated for their potential to produce acid or alkaline soil and water when exposed by mining or other earth disturbance

activities. An acid-base account consists of two measurements: (1) Either total sulfur or pyritic sulfur (where a more detailed quantification is necessary) and (2) neutralization potential. The accounting balances maximum potential acidity (from immediately titratable sources plus sulfuric acid equivalent calculated from total or pyritic sulfur) against total neutralizers (from alkaline carbonates, exchangeable bases, weatherable silicates, or other rock sources capable of neutralizing strong acids) as measured by the neutralization potentials." (Sobek et al, 1978).

"Total sulfur content accurately quantifies potential acidity of materials when all sulfur is present as a sulfide mineral. Sulfide minerals include pyrite, marcasite, chalcopyrite, and pyrrhotite, to name a few. Pyrite is by far the most common and most abundant of the sulfide minerals. Pyrite appears in many crystal forms including cubic, pyrito-hedron and octahedron. Marcasite (white iron pyrites) has the same chemical composition as the more common mineral, pyrite; however, it differs from pyrite in crystal form. Marcasite is orthorhombic and is commonly in tabular crystals flattened to the basal plane. Grouping of the crystals are often called spear pyrites and cockcomb pyrites. When part of the sulfur occurs in nonacid producing forms (sulfate and organic), the maximum potential acidity as calculated will be high. It is for this reason that calculations based on total sulfur are referred to as maximums, and that, in doubtful cases,appropriate acid and water leachings should be able to rule out these forms of sulfur which do not produce acid. From the stoichiometric equation of pyritic sulfur oxidation, the maximum potential acidity can be calculated in terms of

calcium carbonate equivalent (1% sulfur = 31.25 tons of calcium carbonate equivalent per 1,000 tons of material" (Sobek et al, 1978). For this report sulfide minerals will be referred to as pyritic minerals or pyritic sulfur which will include both marcasite and pyrite.

When the acid-base account is calculated, any material with a net potential deficiency of 5.0 tons of calcium carbonate equivalent per 1,000 tons material is deemed "potentially toxic" (Smith et al, 1978). Materials with a pH less than 4.0 on fresh overburden samples (60 mesh, paste pH) are considered to be acid-toxic. (Sobek et al, 1978).

Fizz and Color

Two simple characterizations, fizz and color, were used to aid acid-base accounting on core and disposal area samples.

Fizz is a qualitative visual method to indicate presence of carbonates in less than 60 mesh sample. A 10 percent HCl solution is dropped on a powdered sample to detect an effervescence (bubbling) of the sample in cold dilute HCl. The intensity of the fizz is related to solubility of carbonates. A qualitative rating was assigned as follows: None - no visible effervescence (checked with 20 power microscope); Slight; Moderate; and Strong (strong effervesence on agriculture limestone - 93 percent calcium carbonate equivalent). The fizz rating was used to determine the amount and normality of acid to be used in the neutralization potential procedure. This rating was also used as a sampling guide on bulk core samples and as a sampling guide in disposal area sampling.

Color was determined using Munsel color books. Color was recorded in the laboratory on 60-mesh samples for acid-base accounting. Bulk

sample colors were also determined on core samples. Munsell colors were determined on each layer for field morphologic profile description.

Munsell color on powder core samples was used as a guide to sample characteristics. Low value samples can distinguish highly carbonaceous samples from samples that appear to be black. Chroma was used to distinguish weathered material (high chroma - high value or brown to yellow) from weathered (low chroma - gray) material which may contain concentrations of pyritic material. These color (categories) were used as a guide in the laboratory weighing for total sulfur analysis (more high chroma material is required for sulfur analysis).

Paste pH

Ten grams of sample was mixed with five ml of distilled water and mixed to the consistency of a thin paste. Depending on sample characteristics, more distilled water or more sample may have to be added to obtain the proper consistency. The sample was then read on a pH meter which has been calibrated to pH 4.0 and 7.0 with buffer.

Neutralization Potential (N.P. or Amt. Present)

The neutralization potential procedure measured the amount of carbonates and bases present in core samples and disposal area samples.

A two gram sample is digested in hydrochloric acid at a temperature just below boiling. The volume and normality of the acid depended on the fizz rating assigned to that sample. When digestion was complete, the sample was diluted with distilled water and boiled briefly to remove dissolved carbon dioxide. After cooling to room temperature, the sample was titrated with sodium hydroxide of known normality to pH 7.00 with an expanded scale pH meter. An endpoint of pH 7.00 was maintained 20 to 30

seconds to insure that all iron had been oxidized and precipitated as $Fe(OH)_3$. Blanks were heated and titrated in the same manner as the samples in order to correct for differences in normality between the acid and the base.

The millequivalents of acid consumed in reaction was obtained by difference using mls. of acid added initially, mls. of base required to titrate to neutrality, and the correction factor from the blank. The millequivalents of acid consumed is then converted into tons of calcium carbonate equivalent (Sobek et al, 1978; Jackson, 1958)

Calculations

$$\text{Correction} = \frac{\text{mls. acid-blank}}{\text{mls. base-blank}}$$

Tons $CaCO_3$/1,000 tons material = [mls. acid - (mls. base X Correction)] X 25 X (N acid)

Total Sulfur Analysis

The maximum potential acidity from pyrite oxidation was predicted from measurement of total sulfur content. Total sulfur determinations were made using a Fisher Sulfur Analyzer. The sample was heated to a high temperature in an oxygenated environment, driving off sulfur dioxide. The quantity of sulfur dioxide evolved was measured in a reaction vessel with an electrode equipped with an automatic burette.

A 250 mg sample (low chroma) or 750 mg sample (high chroma) was weighed into ceramic boats that fit into the sulfur furnace.

Vanadium pentoxide or aluminum oxide as a flux was sprinkled over each sample and mixed slightly with the sample to slow the reaction to insure complete combustion. Sulfur standards of 1 percent and 2.5 percent were used to calibrate the analyzer and sample results were

reported in percent. Using the overall equation for the oxidation of pyrite to sulfuric acid, the maximum potential acidity is calculated directly into tons of calcium carbonate equivalent per 1,000 tons material (percent sulfur times 31.25) (Sobek et al, 1978; Smith, 1974).

Sulfur Fractionation

"Total sulfur content accurately quantifies potential acidity of materials when all sulfur is present as pyritic mineral. When gypsum is present or materials are weathered, sulfur occurs in the form of sulfates. Samples high in organic carbon usually contain organic sulfur. Sulfate and organic sulfur do not produce additional acid by oxidation. Appropriate acid and water leachings can be made to determine these sulfur forms" (Sobek et al, 1978, Smith, 1974).

Samples were selected for fractionation on the basis of high total sulfur values with low chroma and low values on Munsell color charts.

A sample (<60 mesh) was thoroughly mixed and three 0.25 g subsamples taken for fractionation. The first sample was analyzed for total sulfur. The second sample placed in a 50 ml Erlenmeyer flask with 25 ml of 2:3 HCl, heated and allowed to cool overnight. The contents of the flask were then filtered with a glass fiber filter, leached thoroughly with distilled water, and allowed to dry. This material was then transferred to ceramic sample boats and total sulfur determined. The third sample was placed in a 50 ml Erlenmeyer flask with 25 ml of 1:7 nitric acid, heated and let stand overnight. The sample was then transferred to glass fiber filter paper and leached with distilled water until nitrates were removed. When the sample had dried, filter paper and contents were placed in a ceramic sample boat and analyzed for total sulfur (modified from Sobek et al, 1978).

--Sulfate sulfur = (total sulfur of untreated sample) - (total sulfur after HCl treatment)

--Pyritic sulfur = (total sulfur after HCl treatment) - (total sulfur after HNO_3 treatment)

--Organic sulfur = (total sulfur after HNO_3 treatment)

Double-Acid Extractable K, Ca, Mg, Na, and P

A five gram sample (<6.35mm for disposal areas and <60 mesh for cores) was extracted with 50 ml of 0.05N HCl and 0.025N H_2SO_4 solution for five minutes on a reciprocating shaker at 120 strokes per minute. Activated phosphorus-free charcoal was then added and dispersed throughout the extracting solution to prevent discoloration. The extract was filtered and the filtrate used to determine levels of phosphorus, calcium, magnesium, sodium, potassium, iron, manganese, zinc, and copper (Nelson, Mehlich and Winters, 1953).

Phosphorus determinations were made with a Perkin-Elmer Coleman 44 spectrophotometer. One ml of molybdate-vanadate solution was added to 4 ml of sample extract. After ten minutes the percent transmittance was measured and recorded. A standard curve was prepared ranging from zero to twenty parts per million. The sample reading was converted into ppm from the standard curve.

Of the two phosphorus methods used in this study, the sodium bicarbonate method is preferred. It has been shown (see Appendix F) that for some disposal areas and core samples, interference from other elements in the double-acid method gives false colors from molybdate-vanadate.

Concentrations of the eight other nutrients were determined by atomic spectroscopy, using a Perkin-Elmer 2380 Atomic Absorption Spectrophotometer. Na and K analysis was done by measuring atomic

emission, while atomic absorption was the method for determining levels of Ca, Mg, Fe, Mn, Cu, and Zn. The atomic absorption spectrophotometer was put into operation according to the unit's instruction manual. Known standards of each element were used to program a standard curve, according to Beer's Law, of concentration versus emission intensity or absorbance directly into the unit's microprocessor-controlled memory. Samples were then aspirated and a concentration reading obtained, which was converted into concentration in the soil by multiplying by the dilution factor. For the Ca and Mg determinations, lanthanum chloride was added to the solution to eliminate chemical interferences.

Sodium Bicarbonate Extractable Phosphorus

A 1.25 gram sample was extracted with 25 ml of 0.5N sodium bicarbonate (adjusted to pH 8.5) to which activated charcoal had been added. The extraction was carried out on a reciprocating shaker operating at 120 strokes per minute for 30 minutes. The sample is filtered and 10 ml of the extract pipetted into a 25 ml volumetric flask. Five ml of ammonium molybdate solution was used to complex the phosphorus. One ml of dilute stannous chloride was added to develop the color. The flask was filled to the mark with distilled water and the contents mixed. After 10 minutes, the sample was read on a Perkin-Elmer Coleman 44 spectrophotometer at 660 nanometers.

Standards ranging from zero to 1.04 ppm were prepared. A graph of absorbance as a function of concentration was drawn up for the standards. Parts per million phosphorus in the sample extracts were determined from the curve and multiplied by a dilution factor of 50 to arrive at parts per million in the soil (Olsen and Dean, 1965; Sobek et al, 1978).

Potassium Chloride Extractable Aluminum

Readily extractable aluminum determinations were made using a 1N KCl extraction (Mclean, 1965). A 2.5g sample (<6.35mm) was extracted with 25 ml extracting solution for one hour on a reciprocating shaker. The sample was filtered and aluminum quantified using a Perkin-Elmer 2380 atomic absorption spectrophotometer in the same manner used for double acid extractable nutrients. Appropriate calculations were then made to express the concentrations in meq/100g of soil.

PHYSICAL CHARACTERIZATION

Selected samples from DA 1504 and DA 1503 were used to evaluate texture and moisture retention.

Soil Texture - Hydrometer Method: A 50g sample was weighed into one-liter french square bottles. One hundred and twenty-five mls of dispersing agent (sodium metaphosphate and sodium carbonate) were added along with 400 ml water. The suspension was placed horizontally on a reciprocating shaker for 16 hours at 120 strokes per minute. After dispersion, the suspension was transferred to a hydrometer cylinder, diluted with distilled water to the calibrated mark and appropriate hydrometer and temperature readings were made. The percent sand, silt, and clay were calculated and USDA soil texture classes were assigned (Sobek et al, 1978).

Moisture Retention Studies

Moisture retention was determined in the laboratory using pressure plate and pressure membrane apparati. Percent moisture was plotted against suctions (tensions) of 0.1, 0.33, 2.0 and 15 bar on selected disposal area samples (<6.35mm). Procedures were followed as outlined

in Field and Laboratory Methods Applicable to Overburdens and Minesoils (Sokek et al, 1978).

Bulk Density by Varsol Method

Bulk density (g/cc) determinations were made on selected disposal area samples using the non-polar liquid Varsol. The method was adapted from Smith (1957) and utilizes Archimedes' Principle. Varsol, being a non-polar liquid, displaces air from clods without slaking the sample. Varsol is an Exxon cleaning fluid and is used because it is inexpensive, easy to obtain, and safe to work with. Other non-polar liquids can be used if found to be more convenient.

Subsampled clods were tied up with light strong thread and an initial moist weight taken. The clods were placed in a vacuum dessicator filled with Varsol. The dessicator was evacuated to a pressure of .3 bars for two hours to saturate the clods with Varsol. Samples were removed and saturated weights obtained. Each clod was suspended in a beaker of Varsol on a prepared balance. By Archimedes Principle, the buoyant force acting on the clod is equal to the mass of Varsol displaced by the clod. The volume displaced was obtained by dividing the mass by the density of Varsol (.77g/cc). Oven dry weights of the clods were obtained after 24 hours in a 105°C oven.

Porosity measurements were also made using the Varsol procedure. The difference between the initial moist weight and the oven dry weight divided by the density of water yields the volume of water filled pores. The difference between the Varsol saturated weight and the initial moist weight divided by the density of Varsol yields the volume of Varsol-filled pores (originally air filled before saturation). Total porosity is a summation of water and air-filled pores. The Varsol procedure

was checked for accuracy by calculating particle density for selected samples.

Calculations

1. $$\text{Volume of Clod} = \frac{\text{saturated weight - suspended weight}}{\text{density of Varsol}} \quad \text{OR}$$

$$\frac{\text{*buoyancy of submerged saturated clod}}{\text{density of Varsol}}$$

*where buoyancy equals the increased weight of a beaker of Varsol when saturated suspended clod is submerged into the Varsol but not touching the beaker.

2. $$\text{Bulk Density} = \frac{\text{grams of dry soil}}{\text{volume of dry bulk soil (clod)}}$$

3. $$\text{Percent Moisture by Volume} = \frac{\text{grams water}}{\text{grams of dry soil}} \quad \text{X 100}$$

4. $$\text{Percent Moisture by Volume} = \frac{\text{grams water}}{\text{volume of dry soil}} \quad \text{X 100}$$

5. $$\text{Percent Air-filled Pores} = \frac{\text{Varsol sat. weight - moist weight}}{\text{density of Varsol}} \ \text{Total Vol. X 100}$$

6. Total Porosity (Percent) = Percent Air-filled pores + Percent water-filled pores.

7. $$\text{Particle Density} = \frac{\text{grams of dry soil}}{\text{Total volume} - \dfrac{\text{\% Total porosity X Total volume}}{100}}$$

Optical Investigations

Core and disposal area samples with high total sulfur values were selected for microscopic examination. A 60 mesh sample was washed with a sodium phosphate solution and dried. The sample was placed under a "bi-noc" scope and identification was made of pyrite present. These samples were split and sent to other professionals for independent evaluation.

Growth Chamber Studies

Soil samples from three locations in each liming treatment in the field plots on DA 1504 were composited and transported to the laboratory to air dry. Each sample was crushed and thoroughly mixed. One kilogram of air-dry soil was placed in an eight-inch tapered plastic pot. A plastic bag was used as a liner. Sufficient water (260 ml) was added to the pot to bring the soil to approximately 80 percent of its water holding capacity. The surface of the soil was allowed to dry until the pot lost 25 ml (grams) of water. The soil surface was disturbed to a depth of one quarter inch and the soil surface was leveled. Approximately 35 weeping lovegrass (*Eragrostis curvula*) seed were sprinkled on the soil surface. The plastic liner was folded over the soil surface to provide a barrier to loss of humidity.

The seeded pots were placed in a Conviron, Model E8H growth chamber. Temperature was maintained at 31°C (88°F) for twelve hours in bright light, at 21°C (78°F) for two hours in dim incandescent light and ten hours in darkness. Light intensity under bright light was approximately 50,000 lux. This intensity is roughly equivalent to a bright, cloudless day in June in the region of the waterway. Humidity in the seed environment was approximately 95 percent. Light was of incandescent and fluorescent sources.

When the plants emerged, the plastic was opened and folded down over the outside of the pots. The pots were weighed and water added daily to maintain soil moisture content at approximately 80 percent of soil capacity.

Ten days after the plants emerged, the plant population was reduced to 20 plants of uniform size in each pot. Plants were removed by

clipping the plant one half inch below the soil surface. Plants were selectively removed to provide uniform spacing among remaining plants and between the pot wall and plants.

Daily watering was increased following plant thinning to maintain soil moisture equal to 90 percent of capacity of the original soil (300 ml). Plant height, color, and general form were evaluated each five days for twenty-five days following plant emergence.

The growth chamber trials of this experiment were conducted twice in the soil collected from each treatment on lime demonstration plots on DA 1504. Three plant species were seeded in the trial pots for the growth chambers. The species were: sericea lespedeza (*Lespedeza cuneata*) crimson clover (*Trifolium incarnatum*) and weeping lovegrass (*Eragrostis curvula*).

R E S U L T S   A N D   D I S C U S S I O N

O V E R B U R D E N   A N A L Y S I S

RESULTS AND DISCUSSION
OVERBURDEN ANALYSIS

Geological Considerations

The Divide Section of the Tennessee Tombigbee Waterway is located solely within the northeastern part of Mississippi. The divide section follows a line from Pickwick Reservoir located in Tennessee to Bay Springs Reservoir presently under construction in Mississippi.

This section of the Tennessee - Tombigbee Waterway transects the Upper - Cretaceous Deposits in northeast Mississippi with the deepest cut for waterway construction at the Tennessee Valley Divide. Sediments in the Divide section are deposits in the Gulf Coastal Plain and its subdivision - the Mississippi Embayment.

Figure 1 illustrates a generalized section of the Cretaceous formations in northeastern Mississippi (Stephenson and Monroe, 1940). The overburden investigated in this report deals with the typical beds of the Eutaw formation and the younger alluvial mantle overlying this formation. The McShan formation, not identified in Figure 1, is shown in profile in Figure 2. Typical beds are similar to Eutaw but the McShan is intermittent and has impacted construction on the southern end of the Divide Section only. The McShan formation was encountered in one core in the study (U894A) and laboratory data revealed little difference between the McShan and the typical Eutaw section.

Figure 2 (Corps of Engineer's geologic profile) shows geologic separations along the Divide section of the waterway. In ascending order the geologic column consists of the Fort Payne formation; the Gordo formation; the McShan formation (intermittent); the Eutaw formation; and the recent alluvial mantle.

NORTHEASTERN MISS.	
Owl Creek Formation	
Ripley Formation Selma Chalk (unnamed tongue) Coffee Sand	
Eutaw Formation	Tombigbee Sand Member Typical beds
Tuscaloosa Formation	

Figure 1

Generalized Section of Upper Cretaceous Formations
of Northeastern Mississippi
(after Stephenson and Monroe, 1940)

PROFILE BB'
(Along C/L of Waterway)

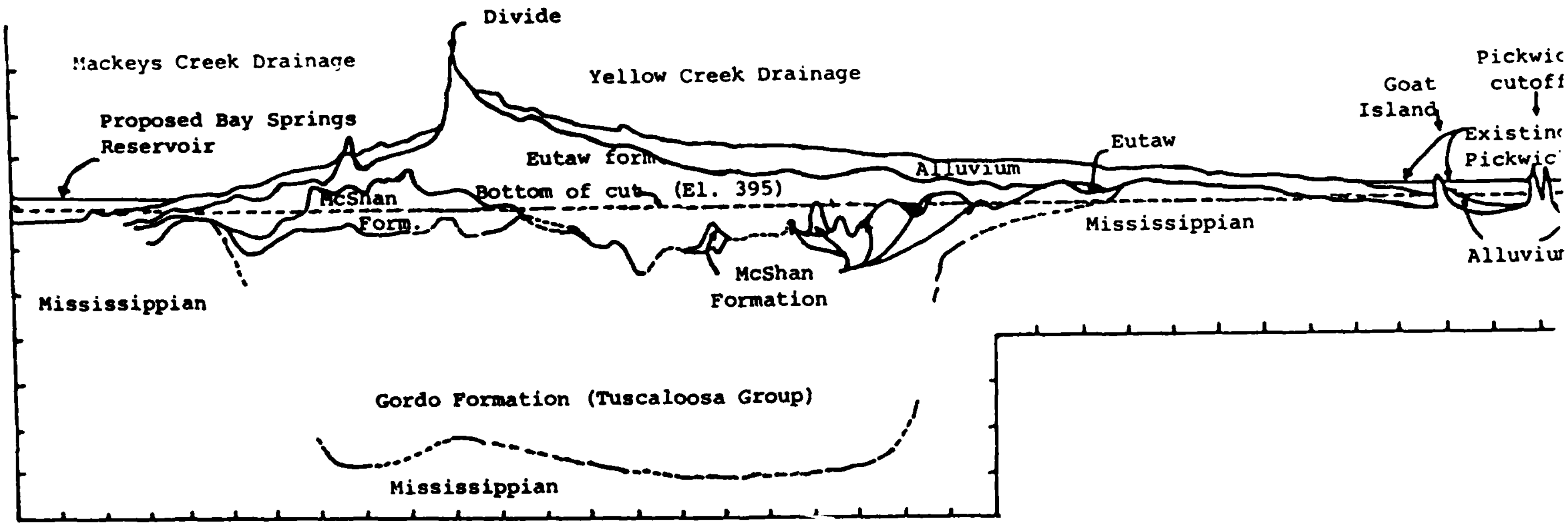


Figure 2
Geologic Profile of the Tennessee Tombigbee Waterway Between
Bay Springs Reservoir and Pickwick Lake

Cretaceous geology is recognized world wide as containing calcareous beds (chalks) but calcareous beds are not present along the Divide section of the waterway (see Figure 2). The material selection for plant growing medium is narrowed to the recent alluvium and the typical Eutaw beds. The success of revegetation of disposal areas is tied directly to the geologic section from which the material is excavated. The typical Eutaw beds are confirmed to have appreciable amounts of pyritic sulfur but lack the excess neutralizers to counteract acidity produced when oxidation occurs. The alluvial mantle contains little pyritic sulfur.

On the Tennessee Valley Divide, the ridgetops are composed of the Tombigbee sand member of the Eutaw formation (Map of Areal Geology Tennessee-Tombigbee Waterway, Divide Cut Section, 1972). Iron concretions in the form of "pipestems" and "iron pans" are present in this material. The Tombigbee sand member is described as a deep water deposited sand and is "more calcareous" than the typical Eutaw beds (Stephenson and Monroe, 1940). Laboratory analysis of the high chroma (weathered portion) and the low chroma (unweathered portion) of the Tombigbee sand member shows that the weathered or upper portion is more calcareous and contains little pyrite.

The alluvial mantle becomes deeper moving north and south from the divide. Two major separations in geology are dominant - the alluvium and the "lower Eutaw". In disposal area 501, geologic materials from the Mississippian and Gordo formation (Tuscaloosa group) are encountered in disposal area fill. Chert gravels from the Mississippian and "irregularly indurated to ferruginous conglomerate" (Stephenson and Monroe, 1940) are readily observed on the surface.

As stated previously, the overburden studied in this investigation concentrates on alluvium and the typical Eutaw beds underneath. As this material is excavated and deposited as a new soil in the disposal areas, it will reflect the character identified by the overburden analysis.

Overburden Core U894A

Overburden core U894A is located at 12,683 + 73.16 ft., 572.78 ft. left of the center line looking north - near the area engineers office on the Divide Section of the waterway (see appendix - for core locations). The upper fifteen feet of core was not sent to Tennessee Tech for overburden analysis. The upper fifteen feet is assumed to be alluvium based on the drillers log sent with samples. Elevation at the top of the drill hole was approximately 467.57 which leaves 71 feet of overburden.

Figure 3, the Acid-Base Account graphic of core U894A, shows potentially toxic material present at the fifteen foot depth (a deficiency greater than 5 tons of calcium carbonate equivalent per 1,000 tons material). These zones should be avoided as plant growth medium. Figure 3 also shows a zone (60 - 75 feet) that chemically has potential for plant growth and contains little total sulfur. A follow-up field inspection during excavation of this material revealed that it is too sandy for adequate moisture retention to sustain plant growth during droughty periods.

Reading Figure 3, the top scale on the left side is the percent total sulfur. The bottom scale is the Acid-Base Account in tons of calcium carbonate equivalent per 1,000 tons of material and the bottom right hand scale is the paste pH. The dotted line in the deficiency column denotes potentially toxic material (Grube, Smith and Ammons, 1973). Any material left of this line should not be placed on the

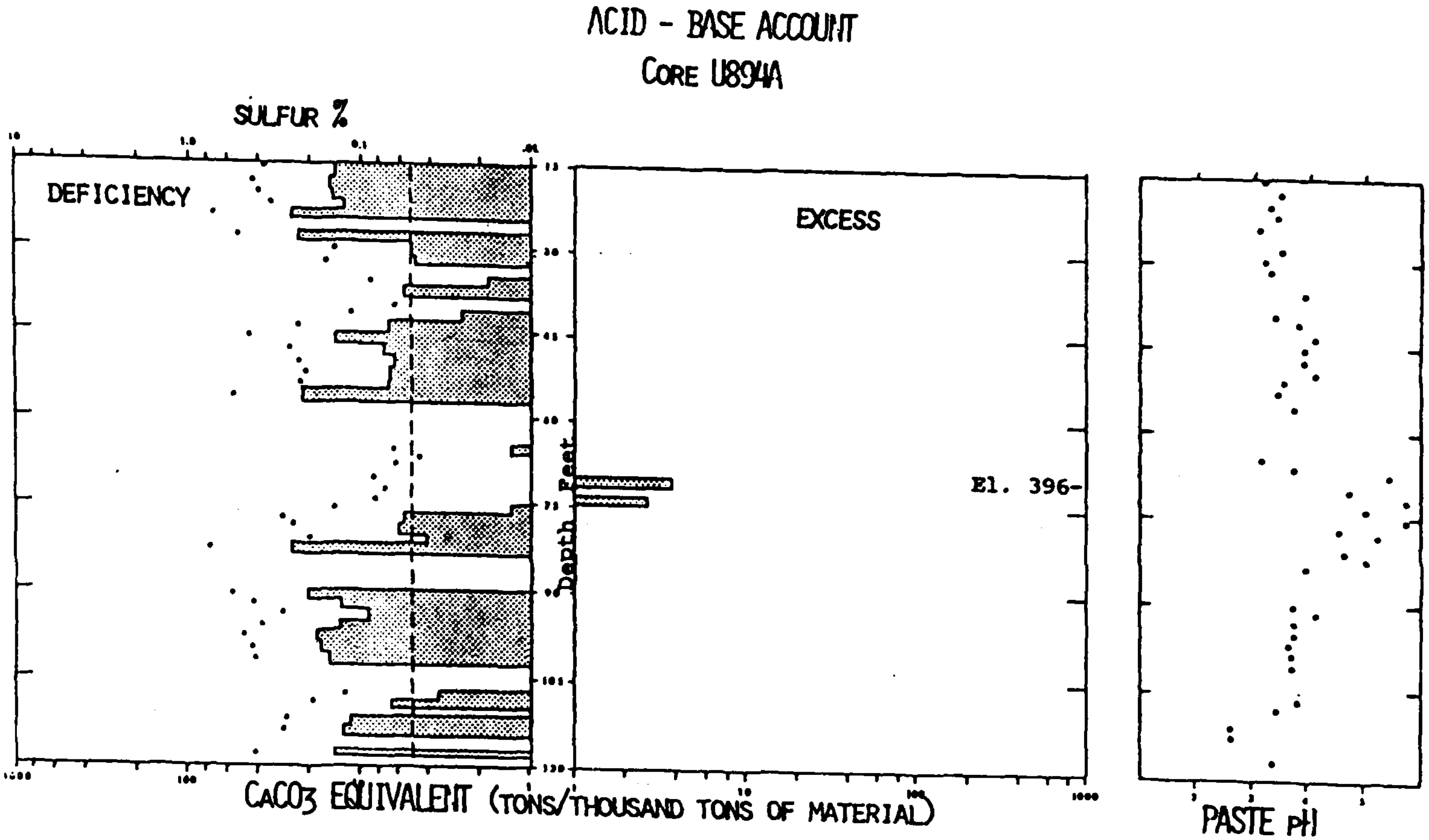


Figure 3. Acid-Base Account, Sulfur Content (dots) and saturated paste pH data of geologic section of Core U894A on the Divide Section - Tennessee Tombigbee Waterway. Shaded bars to the left of the center of the figure indicate the degree to which the acidity or potential acidity exceeds the neutralizing capacity of the material; shaded bars to the right indicate an excess of neutralizing potentials.

surface or in the rootzone. Suitable "plating" material, such as the alluvial mantle, should be used as plating. Overburden material right of this line but not in the excess column should be limed according to Acid-Base Accounting data. Acid-Base account data for Figure 3 is found in Table 1.

Nutrient Status of Core U894A, which compliments Acid-Base Accounting, is found in Table 2. The data, completed on 60 mesh sample, provides an indication of plant nutrient status to use in planning disposal areas and in assessing needs for disposal areas when completed.

Phosphorus levels vary from low to medium in this overburden with the exception of three samples below the bottom cut of the waterway with high levels. Potassium levels are medium to high with few exceptions. Calcium levels are medium to high in the overburden. Magnesium is high to very high with few exceptions. Sodium is adequate for plant nutrition but not at excessive levels to present plant toxicity problems.

Overburden Core U895

Overburden Core U895 is located 12,714 + 20,35 R. The elevation at the top of the bore hole is 461.5 feet. Overburden to be removed in construction is approximately 66 feet thick. Laboratory data were not completed on the top seven feet of this core - samples were not made available to TTU for testing.

Figure 4 is the Acid-Base Account graphic for core U895. The upper 20 feet, which is alluvium, is not potentially toxic but this section lacks excess neutralizers. Additions of lime are necessary to establish sustained vegetative cover. Potentially toxic material is present at the 20 feet depth (see Figure 4). Placement of this material on the

TABLE 1

ACID-BASE ACCOUNT OF CORE U894A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
*1	15.2-16.9	3.2	None	5Y5/2	.3550	11.09	-2.96	14.05	
*2	17.5-19.0	3.5	None	5Y5/2	.4206	13.14	-1.97	15.11	
*3	19.3-21.1	3.3	None	5Y5/2	.3904	12.20	-2.46	14.66	
*4	21.4-23.3	3.4	None	5Y5/2	.3386	10.58	-1.72	12.30	
*5	23.6-25.3	3.1	None	5Y5/2	.7108	22.21	-2.96	25.17	
*6	27.6-28.5	3.5	None	5Y5/2	.5090	15.91	-6.90	22.81	
7	28.7-30.5	3.2	None	5Y5/3	.1406	4.39	- .49	4.88	
8	31.0-32.9	3.3	None	5Y5/2	.1574	4.92	.25	4.67	
9	34.8-36.7	3.9	None	5Y5/3	.0882	2.76	.99	1.77	
10	37.2-38.9	3.4	None	5Y5/2	.1699	5.31	0.0	5.31	
11	39.0-40.8	3.8	None	5Y5/3	.0617	1.93	.99	.94	
12	41.0-42.9	4.1	None	5Y5/2	.1131	3.53	.99	2.54	
13	43.1-45.0	3.9	None	5Y5/2	.2270	7.09	.25	6.84	
14	45.1-47.0	3.9	None	5Y5/2	.4504	14.08	0.0	14.08	

TABLE 1

ACID-BASE ACCOUNT OF CORE U894A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
15	47.2-49.1	4.1	None	5Y5/2	.2623	8.20	.99	7.21	
16	49.3-51.2	3.5	None	5Y5/2	.2260	7.06	.74	6.32	
17	51.4-53.3	3.4	None	5Y5/2	.2015	6.30	- .49	6.79	
18	53.4-54.8	3.7	None	5Y5/2	.2217	6.93	0.00	6.93	
*19	55.1-57.1	3.1	None	5Y5/2	.5496	17.18	-5.17	22.35	
20	64.6-65.9	3.7	None	5Y6/3	.0659	2.06	.74	1.32	
21	66.1-66.9	5.4	None	5Y6/3	.0458	1.43	1.48		.05
22	67.1-67.7	4.7	None	5Y6/3	.0635	1.98	1.91	.07	
23	70.0-71.4	5.7	None	5Y5/3	.0857	2.68	6.53		3.85
24	71.5-73.1	5.0	None	5Y6/3	.0716	2.24	3.20		.96
25	73.2-74.7	5.7	None	5Y6/4	.0824	2.58	5.29		2.72
26	74.9-76.3	4.5	None	5Y5/3	.1436	4.49	3.20	1.29	
27	76.5-78.4	5.2	None	5Y4/2	.2899	9.06	3.45	5.61	

TABLE 1

ACID-BASE ACCOUNT OF CORE U894A

Divide Section - Tennessee Tombigbee Waterway

						$CaCO_3$ Equivalent Tons/1000 Tons Material			
Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
28	78.5-80.4	4.6	None	5Y5/3	.2450	7.66	1.48	6.18	
29	80.5-81.7	5.0	None	5Y5/3	.1982	6.19	2.22	3.97	
*30	82.0-83.7	3.8	None	5Y5/2	.7495	23.42	-1.23	24.65	
31					NO SAMPLE				
32					NO SAMPLE				
*33	90.2-91.6	3.7	None	5Y5/2	.5532	17.29	-2.46	19.75	
*34	92.7-93.2	4.1	None	5Y4/2	.4136	12.93	-1.72	14.65	
35	93.6-95.5	3.7	None	5Y5/2	.2802	8.76	- .49	9.25	
*35	95.7-96.9	3.7	None	5Y5/2	.3794	11.86	-1.72	13.58	
*37	97.0-98.7	3.6	None	5Y5/2	.4931	15.41	-2.71	18.12	
38	98.9-100.7	3.7	None	5y5/2	.4375	13.67	-3.45	17.12	
39	100.9-102.7	3.7	None	5Y5/2	.4084	12.76	-2.46	15.22	
40	107.2-109.1	3.8	None	5Y7/2	.1241	3.88	.33	3.55	

TABLE 1

ACID-BASE ACCOUNT OF CORE U894A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
41	109-2-110.1	3.4	None	5Y6/2	.1931	6.03	- .74	6.77	
42	111.3-113.1	2.6	None	5Y7/2	.2719	8.50	-2.96	11.46	
43	113.3-115.2	2.6	None	5Y6/2	.2848	8.90	-3.69	12.59	
44	117.5-118.1	3.3	None	5Y6/4	.4074	12.73	-1.72	14.45	

* Sulfur Fractionated

TABLE 2

NUTRIENT STATUS REPORT - CORE U894A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
1	15.2-16.9	0.0	272	3294	1571	92
2	17.5-19.0	0.0	411	3834	2246	124
3	19.3-21.1	0.0	345	3402	1379	104
4	21.4-23.3	8.5	358	2997	1182	116
5	23.6-25.3	3.0	261	2781	1099	91
6	27.6-28.5	0.0	90	3159	960	71
7	28.7-30.5	4.5	196	2133	577	53
8	31.0-32.9	3.5	242	2295	568	65
9	34.8-36.7	3.5	257	1998	434	109
10	37.2-38.9	16.5	290	2592	551	65
11	39.0-40.8	3.5	213	1809	374	54
12	41.0-42.9	3.0	281	2538	476	57
13	43.1-45.0	7.0	268	2592	464	53
14	45.1-47.0	1.0	225	2754	460	36

TABLE 2

NUTRIENT STATUS REPORT - CORE U894A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
15	47.2-49.1	4.5	188	2025	362	39
16	49.3-51.2	15.0	323	4779	557	49
17	51.4-53.3	8.0	244	3024	470	36
18	53.4-54.8	16.0	309	2889	439	67
19	55.1-57.1	1.0	416	5632	1127	75
20	64.6-65.9	4.5	124	1215	231	68
21	66.1-66.9	3.5	140	1242	214	83
22	67.1-67.7	5.5	167	1728	290	76
23	70.0-71.4	2.5	197	6264	434	97
24	71.5-73.1	8.5	160	2916	293	79
25	73.2-74.7	6.0	169	3753	366	92
26	74.9-76.3	6.0	228	3780	399	62
27	76.5-78.4	20.0	389	7425	698	83
28	78.5-80.4	5.5	363	5886	784	88

TABLE 2

NUTRIENT STATUS REPORT - CORE U894A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
29	80.5-81.7	3.5	371	5940	703	63
30	82.0-83.7	13.5	430	6642	808	64
31			NO SAMPLE			
32			NO SAMPLE			
33	90.2-91.6	4.5	508	6966	830	87
34	92.7-93.2	20.0	600	6723	761	93
35	93.6-95.5	25.0	383	3861	553	129
36	95.7-96.9	10.0	379	5616	664	58
37	97.0-98.7	13.5	414	7209	834	84
38	98.9-100.7	12.5	381	5832	803	64
39	100.9-102.7	11.5	415	4914	726	79
40	107.2-109.1	8.5	177	1323	235	74
41	109.2-110.1	6.0	205	1620	313	78
42	111.3-113.1	1.0	22	1026	205	21

TABLE 2

NUTRIENT STATUS REPORT - CORE U894A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
43	113.3-115.2	4.0	61	1512	312	25
44	117.5-118.1	10.0	74	2214	448	46

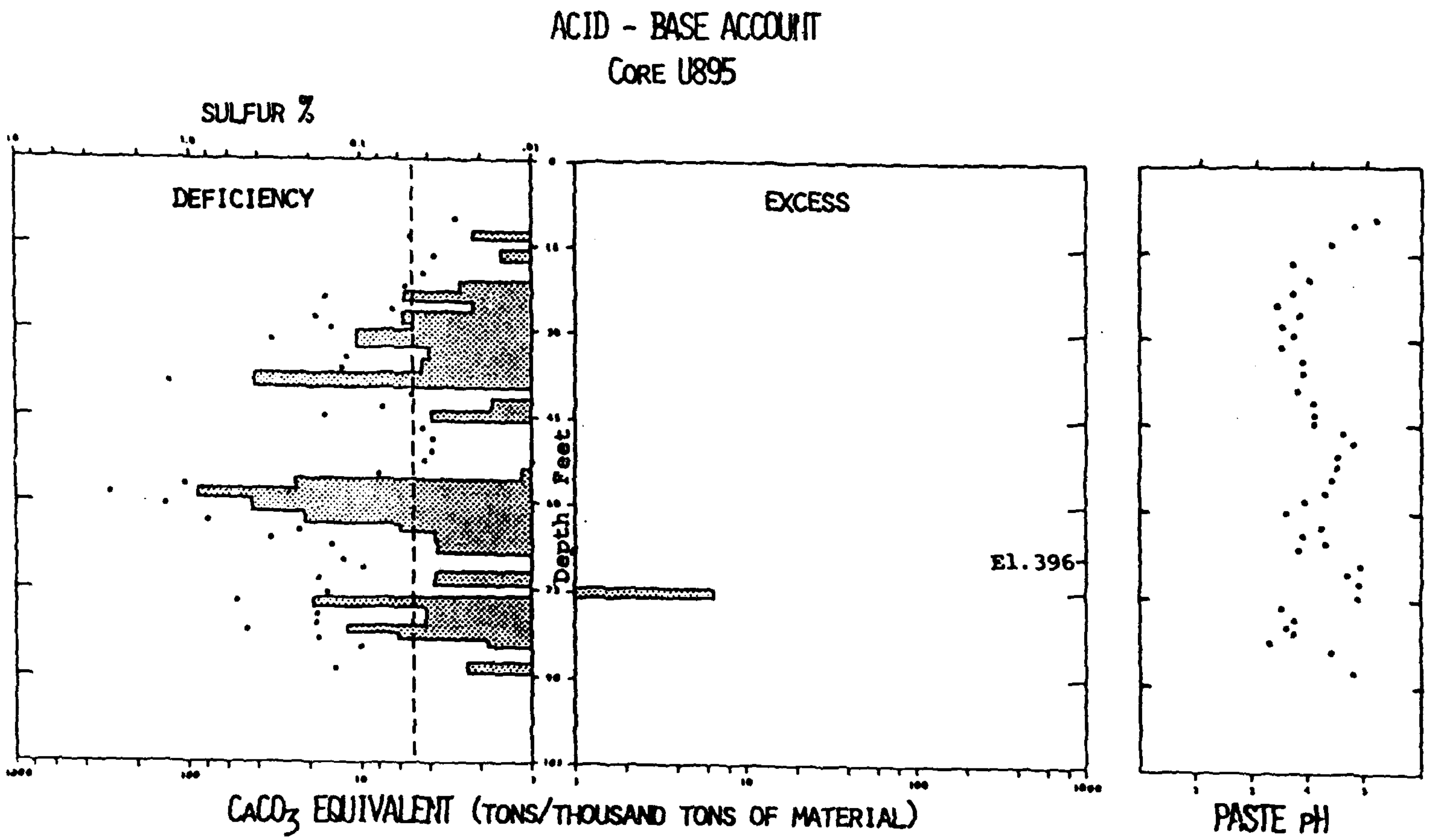


Figure 4. Acid-Base Account, Sulfur Content (dots) and saturated paste pH data of geologic section of Core U895 on the Divide Section - Tennessee Tombigbee Waterway. Shaded bars to the left of the center of the figure indicate the degree to which the acidity or potential acidity exceeds the neutralizing capacity of the material; shaded bars to the right indicate an excess of neutralizing potentials.

surface should be avoided. At a depth of 40 feet, a 10 foot zone of material is available for plant growing medium but this material is difficult to identify in the field. If this zone material is used on the surface of new disposal areas, it should be limed according to Acid-Base Accounting data (see Table 3). Near the bottom of the waterway cut, a zone of potentially toxic material is present. Placement of this material on the surface of disposal areas must be avoided. If during excavation this material is deposited on the surface it should be "plated" or massively limed to establish sustained plant growth. Adequate neutralizers will compensate for oxidation of pyrite which will diminish the chances of erosion. The alluvium is the best "plating" material. Less lime is needed to establish vegetation on the alluvium, which reduces reclamation costs.

Table 4 denotes the nutrient status of core U895. The alluvial portion of the overburden contains high concentrations of sodium bicarbonate extractable phosphorus. The magnesium levels are high to very high with potassium levels ranging from medium to high on the alluvial material. With additions of lime, this is acceptable material for "plating" the Eutaw when constructing new disposal area. This zone (alluvium) shows the lowest percentage of total sulfur in the core and represents the best source of non-pyritic "plating" material.

Overburden Core U895A

The location of core U895A is adjacent to core U895 at 12,713 + 80, 35 R. The elevation at the top of the core hole is 461.7 feet which leaves 65 feet of overburden to be removed. Core U895A is a partial core with representative samples from 5 feet to a depth of 90 feet in the section.

TABLE 3

ACID-BASE ACCOUNT OF CORE U895

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1	7.6-9.0	5.2	None	10YR5/6	.0099	.31	.08	.23	
2	9.2-10.7	4.8	None	2.5Y6/4	.0281	.88	.33	.55	
3	12.7-13.8	4.4	None	2.5Y6/2	.0504	1.58	- .66	2.24	
4	16.2-18.0	3.7	None	5Y6/2	.0380	1.19	- .37	1.56	
5	18.2-21.0	4.0	None	5Y6/2	.0415	1.30	.33	.97	
6	21.2-23.1	3.7	None	2.5Y6/2	.0565	1.77	- .90	2.67	
7	23.3-25.2	3.4	None	2.5Y6/2	.1639	5.12	- .66	5.78	
8	25.4-27.3	3.8	None	5Y6/2	.0645	2.02	- .16	2.18	
9	27.5-29.4	3.5	None	5Y6/2	.1850	5.78	- .16	5.94	
10	29.7-31.6	3.7	None	5Y5/2	.1566	4.89	- .16	5.05	
11	31.9-33.1	3.5	None	5Y5/2	.3453	10.79	.08	10.71	
12	34.1-35.3	3.9	None	5Y6/2	.1259	3.93	- .16	4.09	
13	36.3-37.5	3.9	None	5Y6/2	.1306	4.08	- .16	4.24	
14	38.0-39.9	3.8	None	5Y6/2	1.449	45.28	- .16	45.12	

TABLE 3

ACID-BASE ACCOUNT OF CORE U895

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
15	40.1-42.0	4.1	None	5Y6/3	.0507	1.58	.82	.76	
16	42.1-43.9	4.1	None	5Y6/2	.0755	2.36	.61	1.75	
17	44.1-45.3	4.1	None	5Y6/4	.1699	5.31	1.35	3.96	
18	46.1-47.4	4.6	None	5Y6/3	.0436	1.36	1.35	.01	
19	48.2-49.9	4.8	None	5Y7/2	.0390	1.22	.86	.36	
20	50.1-51.85	4.5	None	5Y7/2	.0393	1.23	1.10	.13	
21	52.1-53.7	4.5	None	5Y7/2	.0425	1.33	.61	.72	
22	54.1-55.9	4.4	None	5Y6/2	.0793	2.48	1.35	1.13	
*23	56.0-57.8	4.3	None	2.5Y5/2	1.062	33.19	9.00	24.19	
*24	58.0-59.4	3.9	None	5Y5/2	2.960	92.50	1.60	90.9	
*25	59.75-61.5	3.6	None	5Y4/2	1.399	43.72	- .86	44.58	
*26	61.7-63.5	4.2	None	5Y5/2	.7820	24.44	3.07	21.37	
27					NO SAMPLE				
28	64.4-65.0	3.8	None	5Y5/3	.2350	7.34	1.35	5.99	

TABLE 3

ACID-BASE ACCOUNT OF CORE U895

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
*29	65.2-66.4	4.3	None	5Y5/3	.3485	10.89	7.24	3.65	
30	66.9-68.7	3.8	None	5Y6/3	.1516	4.74	1.10	3.64	
31	68.9-70.7	4.9	None	2.5Y6/4	.1313	4.10	4.05	.05	
32	70.9-71.9	4.7	None	5Y6/3	.0982	3.07	2.22	.85	
33	72.1-74.1	4.9	None	5Y5/3	.1881	5.88	2.22	3.66	
34	74.3-76.1	4.9	None	5Y5/3	.1676	5.24	11.22		5.98
*35	76.3-77.7	3.5	None	5Y5/2	.5268	16.46	-3.21	19.67	
36	77.9-79.7	3.7	None	2.5Y7/2	.1806	5.64	1.36	4.28	
37	79.9-81.3	3.6	None	5Y6/3	.1847	5.77	1.48	4.29	
38	81.5-82.6	3.7	None	5Y5/3	.4632	14.48	2.22	12.26	
39	82.8-83.9	3.3	None	2.5Y7/2	.1842	5.76	- .27	6.01	
40	84.1-84.7	4.4	None	2.5Y6/4	.1064	3.33	1.48	1.85	
41				NO SAMPLE					
42				NO SAMPLE					
43	87.8-89.2	4.8	None	2.5Y6/4	.1449	4.53	2.10	2.43	

TABLE 4

NUTRIENT STATUS REPORT - CORE U895

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
1	7.6-9.0	140.0	109	1566	372	47
2	9.2-10.7	134.0	237	2862	496	89
3	12.7-13.8	37.0	190	1377	259	29
4	16.2-18.0	16.0	104	540	122	29
5	18.2-21.0	25.5	124	648	145	21
6	21.2-23.1	14.0	78	297	83	13
7	23.3-25.2	19.5	132	752	186	21
8	25.4-27.3	23.0	134	648	139	27
9	27.5-29.4	8.0	198	1917	417	43
10	29.7-31.6	6.5	217	1917	405	44
11	31.9-33.1	9.3	266	2457	417	40
12	34.1-35.3	7.0	207	1809	357	36
13	36.3-37.5	6.0	211	1755	357	36
14	38.0-39.9	5.0	170	1701	338	47

TABLE 4

NUTRIENT STATUS REPORT - CORE U895

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
15	40.1-42.0	6.5	128	1134	231	20
16	42.1-43.9	4.7	118	945	200	32
17	44.1-45.3	5.5	133	1296	264	51
18	46.1-47.4	5.0	136	972	179	60
19	48.2-49.9	4.7	115	891	173	49
20	50.1-51.85	5.0	102	756	142	53
21	52.1-53.7	9.0	106	783	127	51
22	54.1-55.9	11.2	161	1242	233	52
23	56.1-57.8	13.5	186	10287	465	113
24	58.0-59.4	6.5	151	2430	467	31
25	59.8-61.5	6.0	297	3483	567	53
26	61.7-63.5	17.5	157	3348	324	71
27	NO SAMPLE					
28	64.4-65.0	6.5	105	2106	413	40

TABLE 4

NUTRIENT STATUS REPORT - CORE U895

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
29	65.2-66.4	19.5	233	8559	482	83
30	66.9-68.7	12.0	132	1647	259	39
31	68.9-70.7	10.0	192	2403	394	59
32	70.9-71.9	4.7	171	1998	337	58
33	72.1-74.1	12.2	364	3618	608	65
34	74.3-76.1	19.5	193	12285	366	145
35	76.3-77.7	25.5	460	4023	662	58
36	77.9-79.7	12.0	108	1728	165	102
37	79.9-81.3	17.5	151	1971	235	96
38	81.5-82.6	28.0	198	2889	362	54
39	82.8-83.9	9.0	126	972	208	38
40	84.1-84.7	15.7	211	2025	346	100
41		NO SAMPLE				
42		NO SAMPLE				
43	87.8-89.2	12.0	197	1701	340	78

In this core the same trend for selective placement can be followed as discussed in core U895. The upper 20 to 26 feet should be used for "plating" (see Figure 5 and Table 5). Without the intermediate samples, potentially toxic materials may not be identified and core U895 should be consulted for selective placement.

Nutrient status of the upper material (0-26 feet) shows high levels of potassium; low to medium levels of calcium; medium to high levels of magnesium and medium levels of sodium bicarbonate phosphorus (see Table 6).

This core, although a partial sampling, shows approximately the same distribution of total sulfur throughout the section.

<u>Overburden Core U896</u>

Overburden core U896 is located 12,745 + 00,420 R. The elevation at the top of the core hole is 462.8 feet with approximately 66 feet of overburden to be removed during construction. Samples started 3.4 feet from the surface and extended to a depth of 93.9 feet. This core has the highest potential, in quantity, for plant growth medium of the cores examined. Figure 6 shows that 30 to 35 feet of the upper portion is usable as "plating" material either for continuous "haulback" to completed disposal areas or for "stockpiling" for future disposal areas. Potentially toxic materials show up at the 55 foot level and should not be placed on the surface. Table 7, Acid-Base Account of core U896 shows a slight excess of neutralizers from 38 to 53 feet but this material is too sandy for optimum moisture retention if used as "plating." Consistency of excess of neutralizers is observed in all overburden cores studied. These excess neutralizers occur at approximately the 75 foot level. Most of these excess zones of neutralizers are below the bottom cut of the waterway.

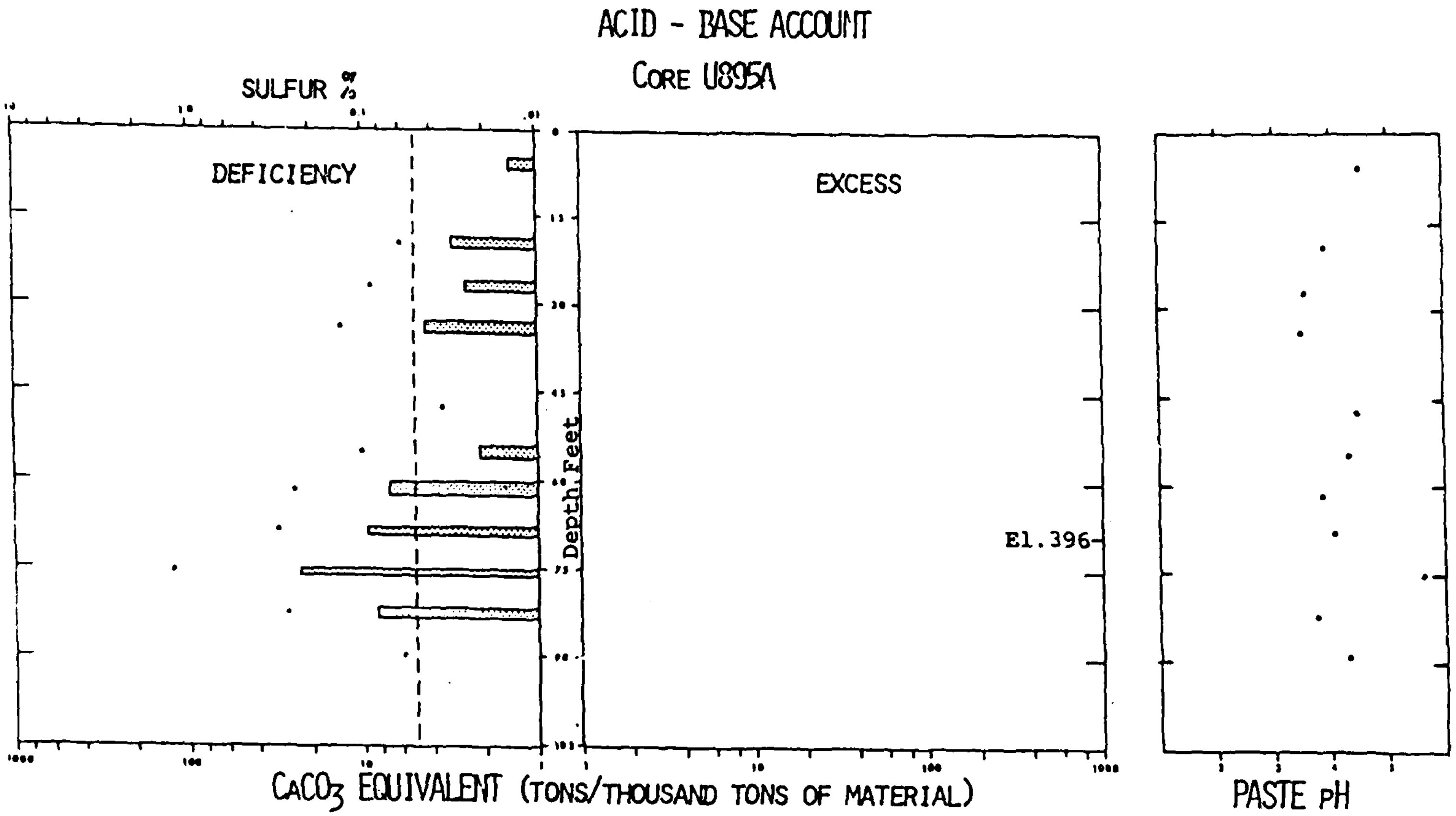


Figure 5. Acid-Base Account, Sulfur Content (dots) and saturated paste pH data of geologic section of Core U895A on the Divide Section - Tennessee Tombigbee Waterway. Shaded bars to the left of the center of the figure indicate the degree to which the acidity or potential acidity exceeds the neutralizing capacity of the material; shaded bars to the right indicate an excess of neutralizing potentials.

TABLE 5

ACID-BASE ACCOUNT OF CORE U895A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1	5.0-6.2	4.6	None	10YR6/4	.0099	.31	- 1.11	1.42	
2	12.0-13.9			NO SAMPLE					
3	19.0-20.4	3.9	None	2.5Y6/2	.0605	1.89	- 1.59	3.04	
4	26.0-27.8	3.6	None	5Y6/2	.0917	2.87	- .12	2.99	
5	33.0-34.7	3.5	None	5Y6/2	.1330	4.16	- .16	4.32	
6	40.0-41.7			NO SAMPLE					
7	47.0-48.8	4.5	None	5Y7/2	.0343	1.07	1.07	.00	
8	54.0-55.8	4.3	None	5Y6/2	.1046	3.27	1.07	2.20	
9	61.1-62.8	3.9	None	5Y6/2	.2522	7.88	.82	7.06	
10	68.0-69.0	4.1	None	5Y6/2	.3078	9.62	.33	9.29	
*11	75.0-75.8	5.6	None	2.5Y6/2	1.280	40.00	16.89	23.11	
12	82.0-83.6	3.8	None	5Y6/3	.2749	8.59	.12	8.47	
13	89.0-90.5	4.3	None	5Y7/3	.0603	1.88	.86	1.02	

*Sulfur Fractionated

TABLE 6

NUTRIENT STATUS REPORT - CORE U895A

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
1	5.0-6.2	13.0	124	1161	402	71
2	NO SAMPLE					
3	19.0-20.4	18.0	177	1026	202	31
4	26.0-27.8	17.8	129	621	141	25
5	33.0-34.7	12.5	262	1782	332	39
6	NO SAMPLE					
7	47.0-48.8	5.5	164	1215	243	31
8	54.0-55.8	12.0	153	1242	221	58
9	61.1-62.8	18.0	195	1728	291	99
10	68.0-69.0	31.0	319	2538	382	49
11	75.0-75.8	62.5	656	15984	1264	128
12	82.0-83.6	17.5	173	1593	255	68
13	89.0-90.5	12.0	178	1188	212	81

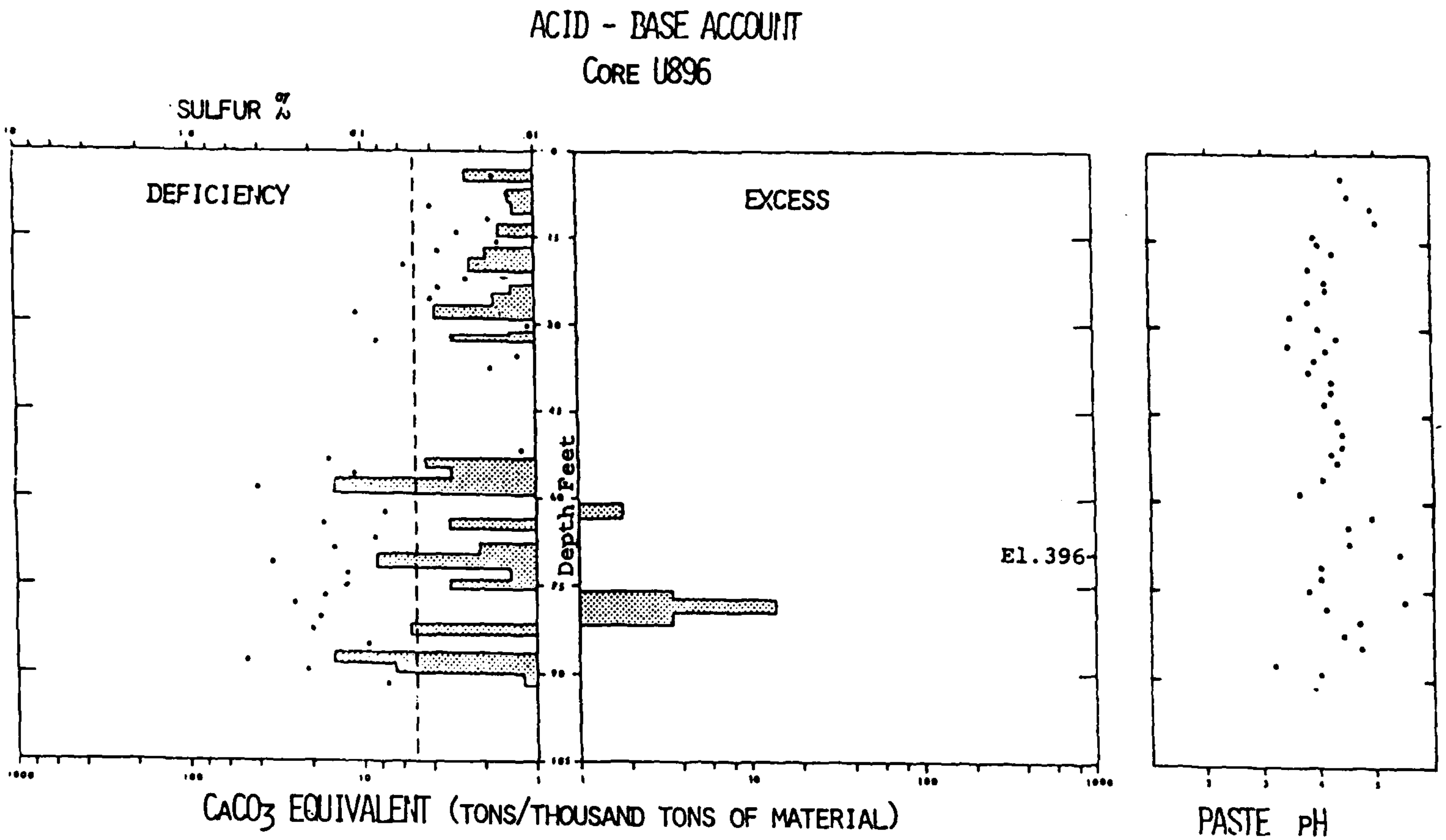


Figure 6. Acid-Base Accounts, Sulfur Content (dots) and saturated paste pH data of geologic section of Core U896 on the Divide Section - Tennessee Tombigbee Waterway. Shaded bars to the left of the center of the figure indicate the degree to which the acidity or potential acidity exceeds the neutralizing capacity of the material; shaded bars to the right indicate an excess of neutralizing potentials.

TABLE 7

ACID-BASE ACCOUNT OF CORE U896

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1	3.4-5.3	4.4	None	10YR6/3	.0174	.54	-1.97	2.51	
2	NO SAMPLE								
3	7.4-9.3	4.5	None	2.5Y7/2	.0135	.42	- .98	1.40	
4	9.4-10.7	4.9	None	2.5Y7/2	.0418	1.31	0.0	1.31	
5	11.4-13.1	5.0	None	10YR6/3	.0185	.58	.25	.33	
6	13.4-14.8	3.9	None	2.5Y6/2	.0293	.92	- .74	1.66	
7	15.2-16.8	4.0	None	2.5Y6/2	.0163	.51	0.0	.51	
8	17.2-19.1	4.2	None	2.5Y6/2	.0379	1.18	- .74	1.92	
9	19.2-21.0	3.8	None	2.5Y6/2	.0549	1.72	- .74	2.46	
10	21.3-23.2	4.1	None	2.5Y6/2	.0205	.64	- .25	.89	
11	23.4-25.0	4.1	None	2.5Y6/2	.0355	1.11	- .25	1.36	
12	25.4-27.1	3.8	None	2.5Y6/2	.0405	1.27	- .49	1.76	
13	28.4-29.3	3.5	None	2.5Y6/2	.1088	3.40	- .49	3.89	
14	29.5-31.3	4.0	None	5Y7/2	.0116	.36	- .25	.61	

TABLE 7

ACID-BASE ACCOUNT OF CORE U896

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
14	29.5-31.3	3.8	None	5Y7/3	.0106	.33	- .69	1.02	
15	31.5-32.0	4.2	None	2.5Y7/4	.0060	.19	-1.15	1.34	
16	32.2-32.8	3.4	None	5Y6/3	.0831	2.60	- .46	3.06	
17	33.0-34.7	4.1	None	5Y7/2	.0082	.26	- .46	.72	
18	34.9-36.4	3.9	None	5Y7/2	.0126	.39	- .23	.62	
19	36.6-38.5	3.8	None	5Y7/2	.0185	.58	0.0	.58	
20	38.7-40.6	4.2	None	5Y7/2	.0078	.24	.46		.22
21	40.8-42.7	4.2	None	5Y7/4	.0078	.24	.69		.45
22	43.4-44.7	4.1	None	5Y7/2	.0092	.29	.69		.40
23	44.9-46.8	4.4	None	5Y7/2	.0064	.20	.92		.72
24	47.0-48.9	4.5	None	5Y8/3	.0065	.20	.69		.49
25	49.1-51.0	4.5	None	5Y7/2	.0061	.19	1.15		.96
26	51.0-53.1	4.2	None	5Y7/3	.0121	.38	.92		.54
27	53.3-55.2	4.3	None	5Y6/2	.1581	4.94	.46	4.48	

TABLE 7

ACID-BASE ACCOUNT OF CORE U896

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
28	55.4-57.0	4.0	None	5Y5/3	.1167	3.65	.46	3.19	
*29	57.2-59.1	3.6	None	5Y5/2	.4093	12.79	-2.29	15.08	
30	61.4-63.3	4.9	None	5Y7/2	.0738	2.31	4.13		1.82
31	63.5-65.4	4.5	None	5Y5/3	.1707	5.33	2.06	3.27	
32	65.6-67.5	4.5	None	2.5Y6/4	.0890	2.78	2.29	.49	
33	67.8-69.7	5.4	None	2.5Y6/4	.1487	4.65	2.52	2.13	
34	70.2-71.9	4.0	None	5Y6/2	.3470	10.84	2.52	8.32	
35	72.1-73.8	4.0	None	5Y6/3	.1262	3.94	2.52	1.42	
36	74.0-75.3	3.8	None	5Y6/3	.1274	3.98	.69	3.29	
37	75.5-77.4	5.5	None	5Y6/3	.1716	5.36	8.95		3.59
38	77.6-79.5	4.1	None	5Y6/3	.2533	7.92	21.92		14.00
39	79.7-81.6	4.7	None	5Y6/3	.1819	5.68	9.18		3.50
40	81.9-83.7	4.4	None	5Y5/3	.2046	6.39	.92	5.47	
41	83.9-85.8	4.7	None	5Y6/3	.0958	2.99	3.67		.68

TABLE 7

ACID-BASE ACCOUNT OF CORE U896

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
42	86.0-87.9	3.2	None	5Y5/2	.4884	15.26	-0.69	15.95	
43	88.1-89.7	4.0	None	5Y6/2	.2148	6.71	0.0	6.71	
44	89.9-91.8	3.9	None	5Y7/3	.0761	2.38	1.15	1.23	

*Sulfur Fractionated

Liming materials from the upper portion of this section to the Acid-Base Account should enable establishment of sustained vegetation.

Table 8, Nutrient Status of core U896, reveals medium to high levels of phosphorus; low to medium levels of calcium; medium to high levels of magnesium; medium to high levels of potassium and sodium levels which are adequate for plant nutrition but not at excessive levels to cause plant toxicity in the material suitable for use as "plating."

The data from core U896 shows that chemically the material in this core has the greatest potential for plant growth. Onsite monitoring by visually observing the alluvial break and using the alluvial material as "plating" will enhance vegetation success on disposal areas.

Overburden Core U897

Core U897 is located 12,834 + 54, 250L. Elevation at the top of the core hole is 451 feet with 55 feet of overburden present.

Figure 7 shows basically the same trend of total sulfur content and neutralizers found in the previous cores. The upper 18 to 20 feet must be used as "plating because the total sulfur concentrations are low and phosphorus concentrations are high. Total sulfur concentrations are higher in the lower Eutaw as shown in Figure 7. Potentially toxic material is present at the 20 foot level and continues downward to the 45 foot level. Avoiding placement of this potentially toxic material on the surface is recommended.

In Table 9, the Acid-Base Accounting data shows the degree of potential acidity in this core. Liming according to the Acid-Base Account on materials deposited from the alluvial mantle on disposal areas is the most logical course toward achieving successful vegetation establishment.

TABLE 8

NUTRIENT STATUS REPORT - CORE U896

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
1	3.4-5.3	25.0	108	702	180	121
2		NO SAMPLE				
3	7.4-9.3	13.5	88	945	507	481
4	9.4-10.7	16.0	94	1107	541	545
5	11.4-13.1	21.0	154	891	285	216
6	13.4-14.8	21.0	154	945	204	111
7	15.2-16.8	15.0	91	513	97	30
8	17.2-19.1	20.0	142	702	169	46
9	19.2-21.0	31.0	141	702	196	25
10	21.3-23.2	18.5	90	459	123	18
11	23.4-25.0	20.0	103	567	129	15
12	25.4-27.1	18.5	91	432	108	22
13	28.4-29.3	18.5	82	378	98	63
14AL	29.5-31.3	16.0	99	459	110	14

TABLE 8

NUTRIENT STATUS REPORT - CORE U896

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
14EU	29.5-31.3	18.5	270	1269	313	37
15	31.5-32.0	20.0	220	1377	331	36
16	32.2-32.8	22.0	185	999	245	127
17	33.0-34.7	25.0	255	1296	310	34
18	34.9-36.4	24.0	241	1377	328	28
19	36.6-38.5	25.5	284	1674	366	33
20	38.7-40.6	25.5	230	1377	298	27
21	40.8-42.7	21.0	229	1269	267	41
22	43.4-44.7	24.0	259	1647	339	41
23	44.9-46.8	34.0	207	1269	280	40
24	47.0-48.9	20.0	164	891	192	54
25	49.1-51.0	20.0	225	1188	244	29
26	51.0-53.1	12.5	194	945	197	52
27	53.3-55.2	10.0	202	2079	397	38
28	55.4-57.0	12.5	229	2727	484	38

TABLE 8

NUTRIENT STATUS REPORT - CORE U896

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
29	57.2-59.1	11.0	328	3565	915	43
30	51.4-63.3	22.5	155	2889	578	87
31	63.5-65.4	40.5	332	4428	887	99
32	65.6-67.5	12.0	185	2538	726	63
33	67.8-69.7	10.5	198	2457	735	89
34	70.2-71.9	30.0	252	3105	774	53
35	72.1-73.8	35.5	198	3564	757	72
36	74.0-75.3	24.0	168	2700	681	63
37	75.4-77.4	18.0	228	3564	768	48
38	77.6-79.5	59.0	178	20736	693	127
39	79.7-81.6	15.0	227	3240	794	37
40	81.9-83.7	17.5	269	3213	818	49
41	83.9-85.8	21.0	205	2916	726	39
42	81.0-82.9	19.5	231	2916	797	38

TABLE 8

NUTRIENT STATUS REPORT - CORE U896

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Bi-carb P (PP2M)	Lbs./1000 Tons of Material			
			K	Ca	Mg	Na
43	88.1-89.7	23.0	250	2592	738	61
44	89.9-91.8	31.0	143	2376	501	53

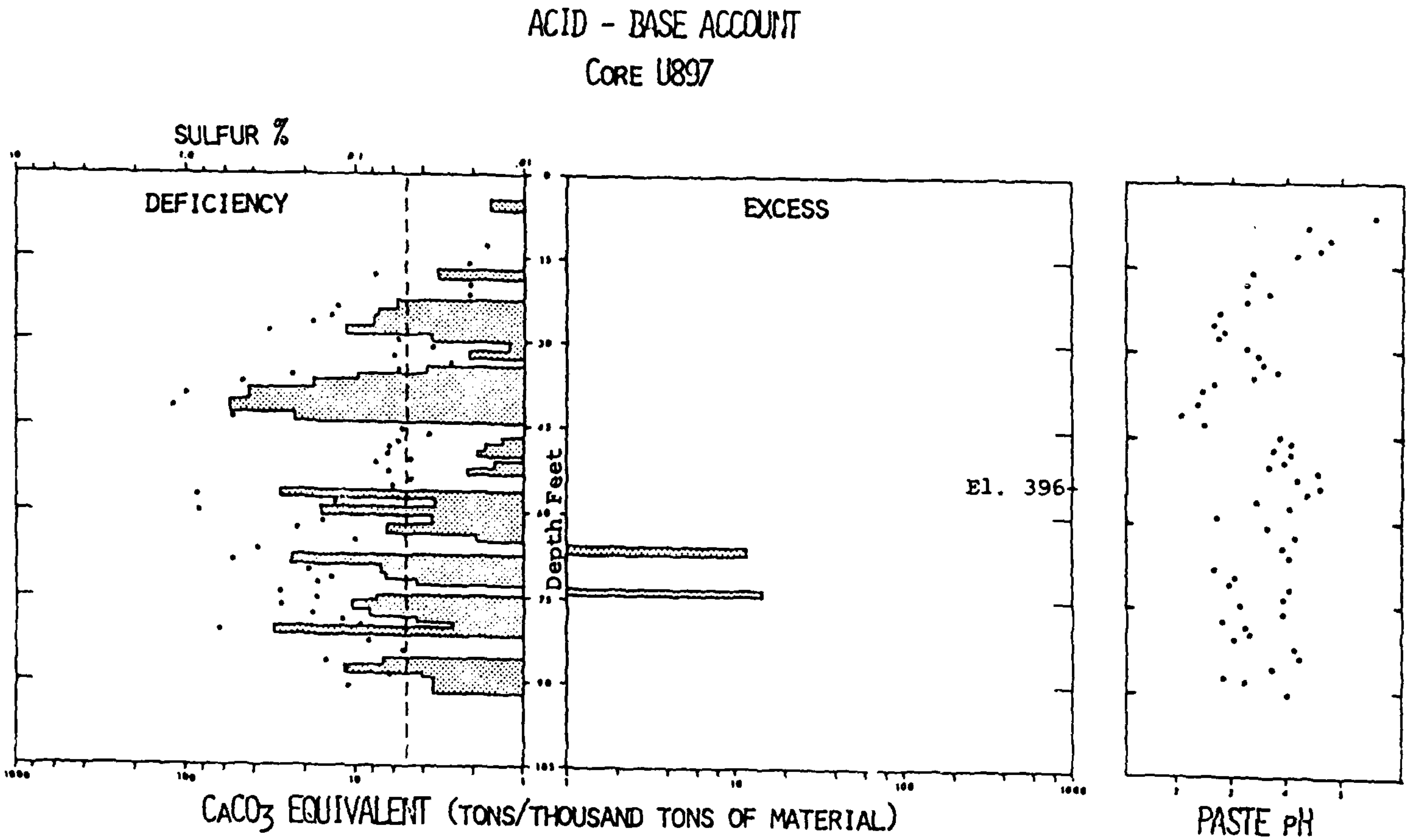


Figure 7. Acid-Base Account, Sulfur Content (dots) and saturated paste pH data of geologic section of Core U897 on the Divide Section - Tennessee Tombigbee Waterway. Shaded bars to the left of the center of the figure indicate the degree to which the acidity or potential acidity exceeds the neutralizing capacity of the material; shaded bars to the right indicate an excess of neutralizing potentials.

TABLE 9

ACID-BASE ACCOUNT OF CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1	5.0-6.4	5.6	None	2.5Y6/4	.0026	.08	-1.55	1.63	
2	7.0-8.8	4.4	None	2.5Y6/6	.0064	.20	0.00	.20	
3	9.0-10.8	4.8	None	5Y7/2	.0071	.22	- .23	.46	
4	11.0-12.8	4.6	None	5Y6/2	.0094	.29	.66		.37
5	13.0-14.8	4.2	None	5Y6/3	.0172	.54	.22	.32	
6	15.0-16.6	3.4	None	5Y7/3	.0213	.67	.22	.45	
7	16.9-18.8	3.3	None	5Y7/2	.0795	2.48	- .89	3.37	
8	19.0-20.8	3.7	None	2.5Y7/2	.0218	.68	.22	.46	
9	21.1-22.8	3.3	None	2.5Y7/2	.0213	.67	- .22	.89	
10	23.0-24.2	2.8	None	2.5Y6/2	.1333	4.17	-1.22	5.39	
11	24.4-25.7	2.7	None	2.5Y6/2	.1434	4.48	-2.88	7.36	
12	25.9-27.5	2.9	None	2.5Y5/2	.1776	5.55	-2.21	7.76	
*13	27.7-28.8	2.8	None	2.5Y6/2	.3333	10.42	-1.55	11.97	
14	29.0-30.1	3.3	None	2.5Y6/2	.0588	1.84	-1.70	3.54	

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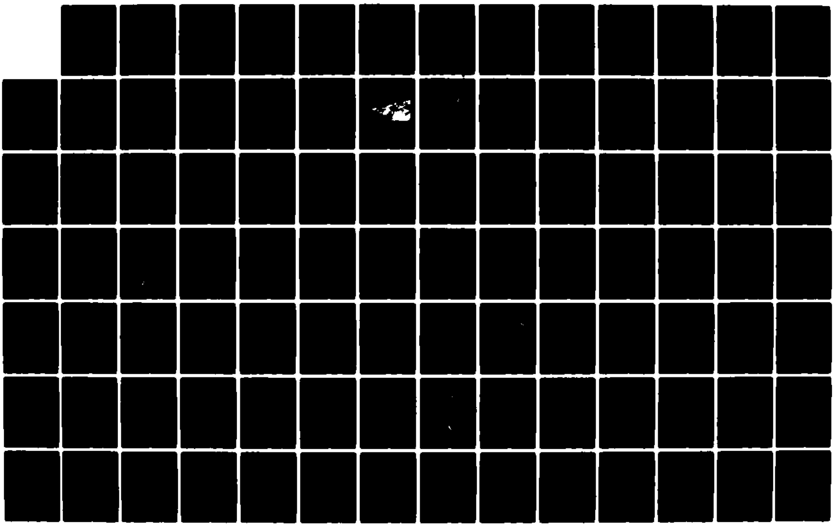

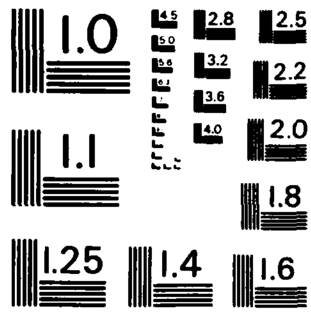

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TABLE 9

ACID-BASE ACCOUNT OF CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
15	30.3-31.8	3.5	None	5Y6/2	.0348	1.09	- .11	1.20	
16	32.0-33.1	3.6	None	5Y7/3	.0606	1.89	- .23	2.12	
17	33.3-34.4	3.9	None	5Y6/3	.0283	.88	1.28		.40
18	34.6-35.7	3.4	None	5Y6/3	.0570	1.78	-2.15	3.93	
19	35.9-36.9	2.7	None	5Y6/3	.2403	7.51	-2.38	9.89	
*20	37.1-38.6	2.5	None	5Y6/3	.4903	15.33	-3.29	18.62	
*21	38.8-40.65	2.4	None	5Y5/2	1.040	32.50	-10.54	43.04	
*22	40.8-42.65	2.1	None	5Y5/2	1.235	38.59	-19.15	57.74	
23	42.8-44.0	2.5	None	5Y5/3	.5481	17.13	-6.01	23.14	
24	44.2-45.8	3.9	None	5Y6/3	.0523	1.63	.82	.81	
25	46.0-47.1	4.1	None	2.5Y6/4	.0363	1.13	1.47		.34
26	47.3-48.3	3.8	None	5Y6/3	.0579	1.18	.45	1.36	
27	48.5-49.4	4.1	None	5Y5/3	.0643	2.01	.23	1.78	
28	49.4-50.2	4.0	None	5Y5/3	.0657	2.05	.11	1.94	

TABLE 9

ACID-BASE ACCOUNT OF CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
29	50.4-51.0	3.7	None	5Y6/4	.0470	1.47	.68	.79	
30	51.2-52.5	4.6	None	5Y5/3	.0775	2.42	.91	1.51	
31	52.7-53.8	4.2	None	2.5Y5/4	.0655	2.05	- .23	2.28	
32	54.0-55.0	4.6	None	2.5Y5/4	.0476	1.49	.80	.69	
33	55.2-56.2	4.4	None	2.5Y5/4	.0619	1.93	1.14	.79	
34	56.4-57.5	3.5	None	5Y5/3	.8894	27.79	- .46	28.25	
35	57.7-58.8	4.1	None	5Y5/3	.1364	4.26	.93	3.33	
*36	59.0-60.7	2.8	None	5Y5/3	.8573	26.80	10.72	16.08	
37	60.9-62.2	3.7	None	2.5Y5/4	.1622	5.07	1.49	3.58	
38	62.4-63.9	4.2	None	2.5Y5/w	.2209	6.90	.21	6.69	
39	64.4-65.5	4.0	None	2.5Y6/4	.1043	3.26	1.29	1.98	
40	65.7-67.2	4.1	None	2.5Y6/2	.3950	12.34	24.71		12.37
41	67.7-69.5	2.7	None	5Y6/3	.5398	16.87	-8.09	24.96	
42	69.7-70.7	3.1	None	2.5Y5/4	.1915	5.98	-1.06	7.04	

TABLE 9

ACID-BASE ACCOUNT OF CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
43	70.9-72.0	3.0	None	2.5Y6/6	.1442	4.51	-2.13	6.64	
44	72.2-73.1	4.1	None	2.5Y5/4	.1722	5.38	1.06	4.32	
45	73.3-74.5	4.0	None	5Y6/3	.2839	8.87	23.65		14.98
46	74.7-75.5	3.2	None	2.5Y5/4	.1754	5.48	-2.13	7.61	
47	75.7-77.0	4.0	None	2.5Y5/4	.2859	8.93	-1.92	10.85	
48	77.2-78.3	2.9	None	2.5Y6/4	.1878	5.87	-2.46	8.33	
49	78.5-79.5	3.3	None	2.5Y6/4	.1217	3.80	- .62	4.42	
50	79.3-80.1	3.4	None	2.5Y6/6	.0961	3.00	.41	2.59	
51	80.3-81.9	3.1	None	5Y5/2	.6488	20.28	-9.85	30.13	
52	82.3-83.8	4.2	None	2.5Y7/2	.0849	2.65	2.33	.32	
53	84.0-85.7	4.3	None	2.5Y7/2	.0517	1.62	1.85		.23
54	85.9-86.9	3.2	None	5Y6/3	.1552	4.85	-2.21	7.06	
55	87.1-88.6	2.9	None	2.5Y6/4	.1153	3.60	-8.21	11.81	

TABLE 9

ACID-BASE ACCOUNT OF CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
56	88.8-89.4	3.3	None	5Y7/4	.0647	2.02	-2.05	4.07	
57	89.6-91.8	4.1	None	2.5Y5/4	.1116	3.49	0.00	3.49	

*Sulfur Fractionated

Table 10 is the plant nutrient status of core U897. The alluvial mantle, usable for "plating", has high concentrations of phosphorus; medium to high concentrations of potassium; low concentrations of calcium; medium concentrations of magnesium and adequate levels of sodium for plant nutrition.

Discussion of all the cores reveals that the alluvium is the best source of "plating" material for the disposal areas. Although narrow zones of chemically favorable material are present in the lower Eutaw, the presence of potentially toxic zones make selective placement difficult. Core U896 contains lower concentrations of sulfur than found in the other cores examined in this study.

Sulfur Fractionation

"Essential ingredients for the formation of pyrite are: sulfate, iron containing minerals, metabolizable organic matter, sulfate reducing bacteria, and anaeroby alternating with limited aeriation" (Pons, Van Breemen and Driessen, 1982).

Selected samples from the overburden were fractionated into organic, sulfate and pyritic sulfur. From Table 11 we see that the percentage of organic sulfur is low with the greatest concentration no more than 8.4 percent of the total sulfur. Sulfate sulfur and pyritic sulfur dominate the sulfur fraction in these overburden samples. Organic and sulfate sulfur do not generate appreciable acidity but pyritic sulfur will generate acidity in an oxygenated environment if sufficient bases are not present to neutralize the acidity being generated.

Pyritic sulfur as used in this study includes the iron disulfide forms of pyrite, pyrrhotite and marcasite. Pyrite was independently

TABLE 10

NUTRIENT STATUS REPORT - CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
1	5.0–6.4'	5.61	52.5	74	934	214	21.6
2	7.0–8.8'	4.41	65.0	90	615	127	25.6
3	9.0–10.8'	4.75	44.5	72	478	102	17.4
4	11.0–12.8'	4.58	36.5	122	592	110	23.2
5	13.0–14.8'	4.22	51.0	120	410	100	27.6
6	15.0–16.6'	3.38	47.0	162	501	114	26.0
7	16.9–18.8'	3.33	45.2	124	706	152	60.0
8	19.0–20.8'	3.63	35.0	112	410	95	28.6
9	20.1–22.8'	3.31	52.5	112	433	93	35.0
10	23.0–24.2'	2.75	49.3	120	1208	310	28.8
11	24.4–25.7'	2.71	55.0	152	1732	451	28.2
12	25.9–27.5'	2.90	51.0	208	1687	456	31.6
13	27.7–28.8'	2.80	47.5	124	980	250	33.4
14	29.0–31.1'	3.26	51.5	142	1254	314	29.8

TABLE 10

NUTRIENT STATUS REPORT - CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
15	30.3-31.8'	3.52	30.0	144	1276	323	29.8
16	32.0-33.1'	3.55	49.3	156	1550	330	40.8
17	33.3-34.4'	3.94	39.0	162	1482	342	36.2
18	34.6-35.7'	3.38	48.5	150	1413	344	29.4
19	35.9-36.9'	2.69	50.5	138	1459	389	23.0
20	37.1-38.6'	2.48	21.3	110	1482	469	20.6
21	38.8-40.65'	2.44	37.2	76	1846	545	20.6
22	40.8-42.65'	2.10	35.5	72	2394	606	28.8
23	42.8-44.0'	2.48	31.3	138	2052	588	38.0
24	44.2-45.8'	3.85	47.5	238	2006	499	49.8
25	46.0-47.1'	4.05	40.5	208	1710	426	39.8
26	47.3-48.3'	3.80	33.0	202	1915	458	31.6
27	48.5-49.4'	4.08	39.0	268	2302	586	43.8
28	46.6-50.2'	4.03	48.5	250	2302	595	66.8

TABLE 10

NUTRIENT STATUS REPORT - CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
29	50.4-51.0'	3.74	42.0	210	1938	478	34.6
30	51.2-52.5'	4.57	47.5	306	2644	604	46.4
31	52.7-53.8'	4.18	51.0	270	2644	750	43.4
32	54.0-55.0'	4.61	46.0	222	2850	768	53.2
33	55.2-56.2'	4.37	48.3	284	6042	624	42.0
34	56.4-57.5'	3.47	47.5	268	2485	647	45.4
35	57.7-58.8'	4.08	33.0	284	2622	752	53.4
36	59.0-60.7'	2.83	80.0	212	15732	973	257.0
37	60.9-62.2'	3.73	42.6	338	3898	788	94.0
38	62.4-63.9'	4.19	76.0	386	3328	814	88.4
39	64.4-65.5'	3.95	31.0	208	2074	513	68.6
40	65.7-67.2'	4.12	78.0	452	15139	1044	191.6
41	67.7-69.5'	2.73	51.0	218	4149	1019	45.0
42	69.7-70.7'	3.07	12.0	194	1755	472	59.8

TABLE 10

NUTRIENT STATUS REPORT - CORE U897

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
43	70.9-72.0'	2.99	10.5	186	1618	476	67.6
44	72.2-73.1'	4.06	9.5	294	1846	565	65.2
45	73.3-74.5'	4.03	67.5	306	19448	836	296.2
46	74.7-75.5'	3.19	13.0	230	2097	565	49.6
47	75.7-77.0'	3.99	23.0	282	2872	852	75.6
48	88.2-78.3'	2.91	13.0	176	1824	467	51.0
49	78.5-79.5'	3.28	14.0	244	1527	456	74.4
50	79.3-80.1'	3.44	14.0	202	1482	374	91.0
51	80.3-81.9'	3.11	26.0	732	4081	1283	97.2
52	82.3-83.8'	4.24	68.0	136	2713	143	143.4
53	84.0-85.7'	4.32	47.0	160	2188	203	138.8
54	85.9-86.9'	3.23	23.0	234	1710	467	86.4
55	87.1-88.6'	2.94	17.5	204	1459	360	61.6
56	88.8-89.4'	3.26	16.0	160	1094	246	73.0
57	89.6-91.8'	4.12	16.0	226	2092	519	63.4

TABLE 11

SULFUR FRACTIONATION OF SELECTED CORE SAMPLES

Divide Section - Tennessee Tombigbee Waterway

Core Number	Sample Number	Total S(%)	Pyritic S(%)	Sulfate S(%)	Organic S(%)
U 894 A					
	1	.3550	.1070	.2306	.0174
	2	.4206	.1657	.2372	.0177
	3	.3904	.1171	.2569	.0164
	4	.3386	.1133	.2253	.0000
	5	.7108	.4147	.2961	.0000
	6	.5090	.1405	.3685	.0000
	14	.4504	.2621	.1646	.0237
	19	.5496	.1611	.3732	.0153
	30	.7495	.4496	.2717	.0282
	33	.5532	.2690	.2640	.0202
	34	.4136	.1995	.1936	.0205
	36	.3794	.1708	.1944	.0142
	37	.4931	.1788	.2983	.0160

TABLE 11

SULFUR FRACTIONATION OF SELECTED CORE SAMPLES

Divide Section - Tennessee Tombigbee Waterway

Core Number	Sample Number	Total S(%)	Pyritic S(%)	Sulfate S(%)	Organic S(%)
U 895 A					
	11	1.280	1.1441	.0950	.0409
U 895					
	14	1.449	1.3777	.0180	.0533
	23	1.062	.8560	.1559	.0501
	24	2.960			.1281
	25	1.399	1.1641	.1560	.0789
	26	.7820	.6044	.1404	.0372
	29	.3485	.1452	.1877	.0156
	35	.5268	.3020	.2069	.0179
U 896					
	29	.4093	.2040	.1897	.0156
U 897					
	13	.3333	.2591	.0461	.0281
	20	.4903	.2232	.2488	.0183
	21	1.040	.5078	.5072	.0250

TABLE 11

SULFUR FRACTIONATION OF SELECTED CORE SAMPLES

Divide Section - Tennessee Tombigbee Waterway

Core Number	Sample Number	Total S(%)	Pyritic S(%)	Sulfate S(%)	Organic S(%)
U 897 (Continued)					
	22	1.235	.3733	.7981	.0636
	36	.8573	.3599	.4537	.0437

verified as the form of inorganic sulfur in core samples on the Divide Section of the waterway.

When pyrite undergoes oxidation it generates sulfuric acid and the reaction is "$4FeS_2$ + $15O_2$ + $14H_2$ --- 4 $Fe(OH_3)$ + $8H_2SO4$". This reaction proceeds slowly in three stages with the first and second stages being the rate determining steps.

(1) $2FeS_2 + 7O_2 + 2H_2O$ --- $2FeSO_4 + 2H_2SO_4$

(2) $4FeSO_4 + 2H_2SO_4 + O_2$ --- $2Fe_2\ (SO_4)_3 + 2H_2O$

(3) $Fe\ (SO_4)_3 + 6H_2O$ -- $2Fe(OH)_3 + 3H_2SO_4$

In nature, the reaction may proceed slowly over a long period of time through intermediate steps and depends on the activity of micro-organisms, concentration of Fe (III), partial pressure of O_2, and other environmental variables (WVU, 1971)."

If the clay fraction is low, less than 0.5 percent pyritic sulfur may make soil potentially acid. If the clay fraction is high in smectite clay, the bases on the clay exchange complex are capable of inactivating most of the acidity released by the oxidation of up to 0.5 percent pyritic sulfur (Pons, Van Breemen and Driessen, 1982). The low clay percentages in the overburden material along the Divide Section plus the pyritic sulfur values (Table 11) contribute to potentially acid soils in the disposal areas.

Figure 8 illustrates the relationship between total and pyritic sulfur on the selected core samples. Acid-Base Accounting is calculated using total sulfur values, making the assumption that all sulfur is pyritic. Total sulfur values on the overburden samples closely correlate with pyritic sulfur fraction (Figure 8). Using total sulfur values will add a margin of safety for calculating acidity produced from sulfur.

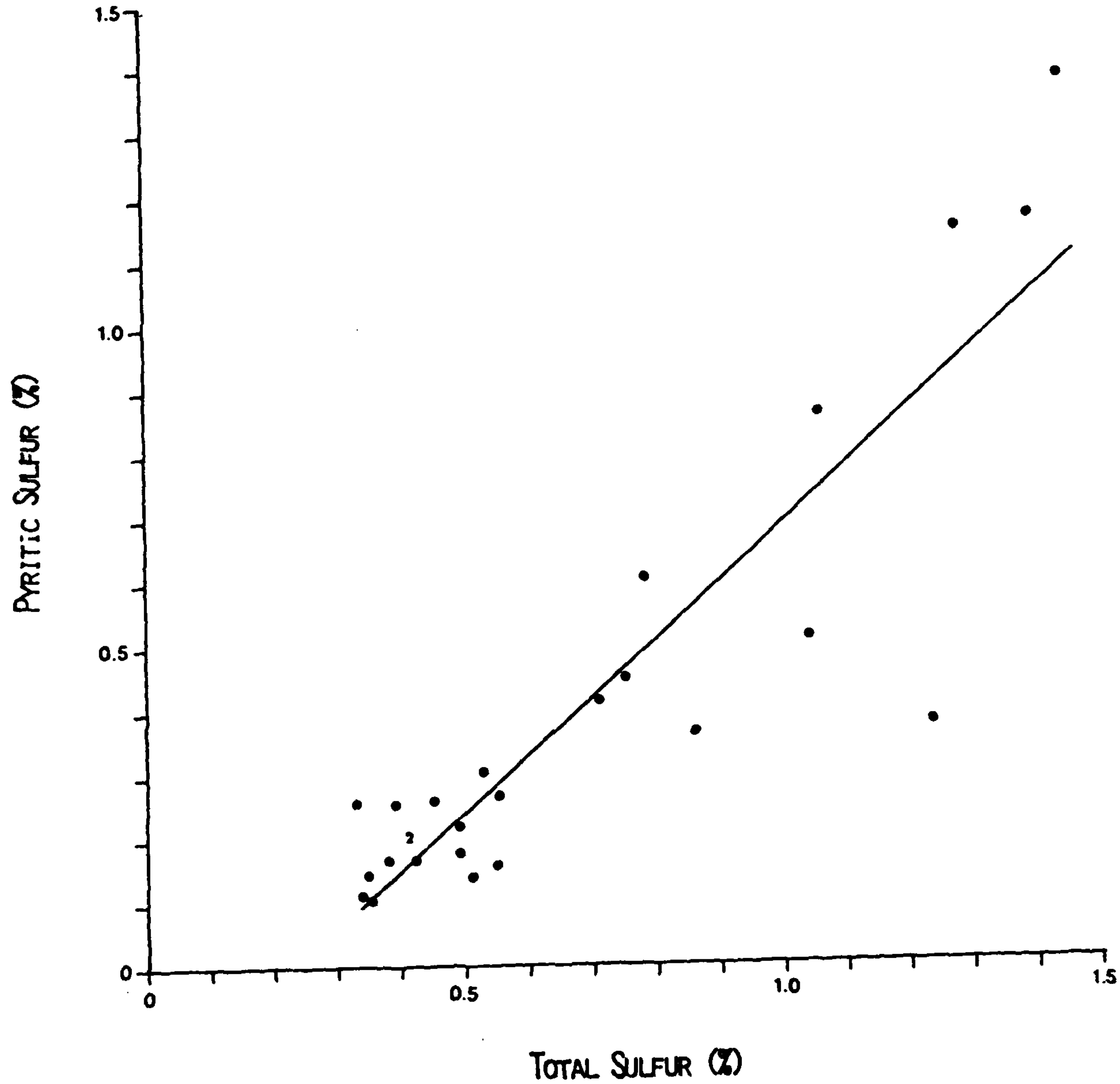

Figure 8. Relationship between Total and Pyritic Sulfur.

As previously mentioned, the organic sulfur fraction is low in the overburden cores with sulfate and pyritic sulfur dominating. Organic carbon (lignite) material was found in some samples and contained crystals of pyrite. No continuous layer of carbolithic (carbon) materials was found in the overburden which verifies laboratory data showing low organic sulfur.

The study of overburden in advance of excavation is most useful in determining which materials are suited for plant growth and ultimate environmental quality. The oxidation of the pyrite coupled with low concentrations of neutralizers in the overburden account for most of the acidity observed in disposal areas. Also, the sandy textures contain low amounts of clay for the exchange of basic cations which would offset some acidity produced through oxidation.

R E S U L T S A N D D I S C U S S I O N

D I S P O S A L A R E A S

C H E M I C A L C H A R A C T E R I Z A T I O N

RESULTS AND DISCUSSION
DISPOSAL AREAS CHEMICAL CHARACTERIZATION

General

Chemical characterization sampling on the disposal areas was guided primarily by the presence of healthy vegetation or by the presence of stressed and dead vegetation. We felt that initially we should sample at two depths, 0-4 inches and 4-8 inches or on the natural morphologic break. We established at what depth lime was incorporated and established an idea of depth of oxidation. On disposal areas 1503, 1504 and 1704 soil profiles were excavated and sampled to a depth of at least 40 inches establishing morphological character and extending chemical characterization. Deep disturbance of pyritic materials will bring material back to the surface that starts the oxidation cycle again, thus inhibiting plant establishment.

Chemical parameters studied were as follows: Acid-Base Accounting; pH; calcium; magnesium; potassium; sodium; phosphorus; iron; manganese; zinc; copper and KCl extractable aluminum. From these parameters we establish at what level plants are sustaining and at what levels they are dying. Once this is confirmed, the level of neutralizers to sustain vegetation can be added in combination with needed plant nutrients, accelerating vegetation of problem areas. Discussion of each disposal area is referred generally to sampling points or areas and presented in the sequence that each was sampled.

Disposal Area 1504

The general condition of disposal are 1504 shows good vegetation on the extreme southern end (samples A through E) with the remaining

portion essentially void of vegetation except for dead plant remnants and isolated pockets of stressed plants - pyrite oxidation is evident.

Through the loss of vegetation on this disposal area, extreme erosion developed. During the period of investigation (one year) the formation of rills and subsequent formation of gullies was noted (Figure 9). Figure 10 denotes each sampling point for disposal areas 1503 and 1504.

Sampling depths on this area were mostly 0-4 inches and 4-8 inches. One pit (Pit number 1504-1) was excavated to note the differences in material down to 40 inches. Results from this pit are discussed in the soil profile section. Lime test plots are located on this disposal area and results from these plots are discussed in the vegetation section.

The history of revegetation efforts point to a deficiency in neutralizers to offset acidity produced by pyrite oxidation. Corps of Engineer personnel stated that this area was limed, fertilized, and vegetative cover established. After a four to six month period, the vegetation began dying - insufficient neutralizers were present to counteract acidity produced. In only one area have excess neutralizers on disposal area 1504 been found. This is the extreme southern end which is well vegetated (sampling A through E). This material originated in the upper portion of the geologic section possibly in the weathered Tombigbee sand member that is present on the ridgetops near the divide.

Table 12 is the Acid-Base Account of disposal area 1504. Samples A through E had pH values above 4.0 and all except E had excess neutralizers. Sample E had only a slight deficiency of neutralizers. These conditions were suitable for sustaining vegetation. Moving northward in the disposal area, we found varying degrees of acidity each contributing to the loss of vegetation.

Figure 9. Erosion gullies formed after vegetation failures on disposal area 1504.

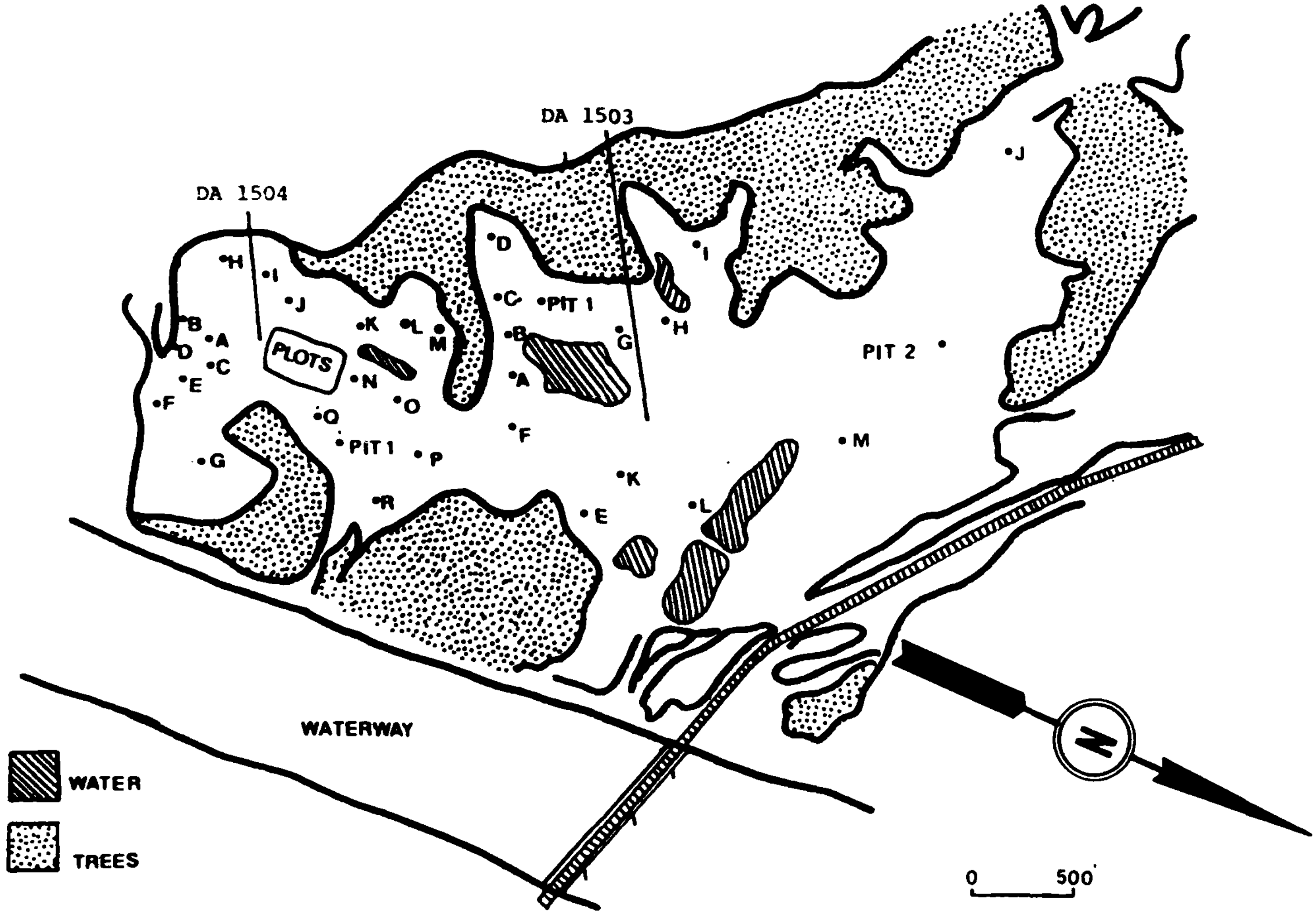

Figure 10. Sample locations on disposal areas 1503 and 1504

TABLE 12

ACID-BASE ACCOUNT OF DA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
A1	0-4"	6.32	None	10YR6/4	.0116	.36	3.15		2.79
A2	4-8"	4.78	None	10YR6/4	.0098	.31	.69		.38
B1	0-4"	6.46	None	10YR6/4	.0110	.34	2.31		1.97
B2	4-6"	5.34	None	10YR6/4	.0128	.40	.46		.06
C1	0-4"	6.34	None	10YR6/4	.0101	.32	1.37		1.05
C2	4-8"	5.93	None	10YR6/4	.0104	.33	.69		.37
D1	0-4"	5.24	None	10YR5/4	.0071	.22	.74		.52
D2	4-8:	4.84	None	10YR5/6	.0071	.22	.58		.36
E1	0-4"	4.36	None	10YR5/4	.0159	.50	- .29	.79	
E2	4-8"	4.10	None	10YR5/6	.0190	.59	- .29	.88	
F1	0-4"	2.65	None	10YR6/3	.1374	4.29	-3.79	8.08	
F2	4-8"	2.65	None	10YR5/3	.2068	6.46	-4.73	11.19	
G1	0-4"	2.65	None	10YR6/3	.2379	7.43	-3.88	11.31	
G2	4-8"	2.58	None	10YR6/4	.1686	5.27	-4.15	9.42	

TABLE 12

ACID-BASE ACCOUNT OF DA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
H1	0-4"	3.1	None	10YR5/3	.0869	2.72	-3.23	5.95	
H2	4-8"	3.2	None	10YR5/4	.0740	2.31	-2.74	5.05	
I1	0-4"	4.9	None	10YR5/4	.0210	.66	.46	.20	
I2	4-8"	4.9	None	2.5Y6/2	.0195	.61	- .91	1.52	
J1	0-4"	2.6	None	10YR5/4	.4362	13.63	-9.14	22.77	
J2	4-8"	2.5	None	10YR5/4	.3746	11.71	-8.31	20.02	
K1	0-4"	2.4	None	10YR5/3	.4633	14.48	-12.46	26.94	
K2	4-8"	2.4	None	10YR5/4	.4386	13.71	-9.69	23.40	
L1	0-4"	2.7	None	10YR5/6	.1081	3.38	-4.38	7.76	
L2	4-8"	2.5	None	2.5Y5/6	.1426	4.46	-4.57	9.03	
M1	0-4"	2.5	None	2.5Y6/4	.2547	7.96	-6.49	14.45	
M2	4-8"	2.4	None	2.5Y6/4	.2908	9.09	-7.18	16.27	
N1	0-4"	3.3	None	2.5Y5/6	.0411	1.28	-1.31	2.59	
N2	4-8"	3.1	None	10YR6/4	.1585	4.95	-1.93	6.88	

TABLE 12

ACID-BASE ACCOUNT OF DA 1504

Divide Section - Tennessee Tombigbee Waterway

						$CaCO_3$ Equivalent Tons/1000 Tons Material			
Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
01	0-4"	3.4	None	2.5Y6/4	.0262	.82	-1.58	2.39	
02	4-8"	3.3	None	2.5Y6/4	.0606	1.89	-2.05	3.94	
P1	0-4"	4.4	None	10YR5/2	.0291	.91	- .41	1.32	
P2	4-8"	3.9	None	10YR6/2	.0460	1.44	-1.58	3.02	
Q1	0-4"	2.8	None	2.5Y6/4	.0733	2.29	-3.55	5.84	
Q2	4-8"	2.6	None	2.5Y5/6	.1027	3.21	-4.14	7.35	
R1	0-4"	4.3	None	10YR5/3	.1166	3.64	.83	2.81	
R2	4-8"	3.3	None	2.5Y5/4	.0803	2.51	-1.93	4.44	

In Table 12, samples F through R show a deficiency of neutralizers. In some samples, a minimal amount of additional lime will support vegetation. Sampling points J, K, M and L all show extremely acidic conditions. The amount of sulfur is significant in these samples and with low concentrations of neutralizers and sandy conditions, pyrite oxidation is prominent. These areas are contained by a berm keeping sediments onsite.

As mentioned in the overburden section, this area contains materials from the McShan as well as the typical Eutaw beds. A definite separation has not been made because the sediments both contain pyrite. The McShan formation was identified on 1503 and 1504 previously by the presence of amber. Amber may also be present in the typical Eutaw beds, making the separation between McShan and Eutaw difficult.

Revegetation of this area requires levels of lime that meet the Acid-Base Account data. Severely eroded, strongly sloping areas are top priority for revegetation. Those areas that are gently sloping and controlled by a berm are lower priority. Offsite sediment is mostly controlled on this area by diversions and a series of sediment structures.

Observations on newer disposal areas show that oxidation occurs rapidly. Acidity produced by oxidation of pyrite was neutralized for a period of time by a four ton per acre lime rate in disposal area 1504 but this amount of lime was not sufficient to neutralize all of the acidity produced.

Sampling points O, P, Q, N and R can be vegetated with a 5 to 7 ton per acre rate incorporated to six inches if adequate mulch (4 ton/A) is used to stabilize slopes. Sampling points H, I, J, K are contained within a berm and provide an excellent opportunity to study invading vegetation as that area begins to stabilize after extensive oxidation.

Table 13 shows the major plant nutrients on disposal area 1504. Levels of these nutrients are not low enough to affect establishment of permanent vegetation - only the levels of neutralizers are insufficient as shown by the pH values. Potassium values are high to medium except for samples F, H1 and J through N which have low concentrations. Calcium is medium to high except sample H1. Magnesium high to very high in most samples, with a few in the medium range. Sodium is adequate for plant nutrition but not at excessive levels to cause salt toxicity problems. The bicarbonate extractable phosphorus values are high to very high in this disposal area. The oxidation of pyrite produces sulfuric acid which attacks primary phosphate minerals in the overburden material. This in turn produces phosphoric acid or phosphate fertilizer. High phosphorus values have been noted in many of the disposal areas and this weathering phenomenon is believed responsible for these high values. Past experience with pyritic overburden and related minesoils in surface mining research indicates that fertility levels for some elements are high in association with pyritic sulfur, providing adequate plant growth medium if ample neutralizers and nitrogen are added.

Other evidence of pyrite oxidation on this disposal area includes the formation of some of the common aluminum sulfate minerals. Some that have been observed on this disposal area are copiapite (yellow to orange), melanterite (white with bluish tint) and alunite (white). All of these aluminum sulfate minerals have a bitter taste. Where lime is added, gypsum (a neutral salt) will form as a combination between calcium and sulfate ions. Gypsum does not impede plant growth and in the western United States, gypsum is credited with improving soil permeability. Gypsum does not have a bitter metallic taste and is distinguished from alunite on this basis in the field. (Nettleton et al, 1982).

TABLE 13

NUTRIENT STATUS REPORT - DISPOSAL AREA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
A1	0-4"	6.11	21.4	148	3807	472	30
A2	4-8"	5.07	12.0	122	1915	488	30
B1	0-4"	6.43	54.7	118	3032	260	26
B2	4-8"	5.54	75.0	132	2302	394	24
C1	0-4"	6.56	34.0	228	2792	396	34
C2	4-8"	6.06	23.0	92	1641	262	22
D1	0-4"	5.29	41.5	172	1504	296	32
D2	4-8"	5.18	21.5	72	1117	339	20
E1	0-4"	4.48	40.0	132	1596	396	30
E2	4-8"	4.10	22.5	120	1140	401	32
F1	0-4"	2.71	53.0	96	1915	426	28
F2	4-8"	2.65	17.4	68	1824	668	28
G1	0-4"	2.51	17.0	40	2439	738	16
G2	4-8"	2.61	21.4	52	1778	645	26

TABLE 13

NUTRIENT STATUS REPORT - DISPOSAL AREA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
H1	0-4"	3.01	18.8	58	570	141	22
H2	4-8"	3.11	17.4	84	1140	180	26
I1	0-4"	4.75	50.5	220	2325	319	34
I2	4-8"	3.64	18.0	152	1026	275	30
J1	0-4"	2.66	49.5	34	1710	1105	38
J2	4-8"	4.72	32.7	40	2713	823	32
K1	0-4"	2.41	49.5	26	1915	820	28
K2	4-8"	2.42	43.3	20	3123	538	32
L1	0-4"	2.62	51.4	44	957	148	42
L2	4-8"	2.42	25.4	34	1801	177	32
M1	0-4"	2.33	67.0	36	1869	467	34
M2	4-8"	2.23	15.2	34	2599	474	32
N1	0-4"	3.39	21.4	104	2667	273	42
N2	4-8"	3.07	25.0	116	2006	419	44

TABLE 13

NUTRIENT STATUS REPORT - DISPOSAL AREA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
O1	0-4"	3.45	31.8	260	1459	419	56
O2	4-8"	3.23	18.8	162	957	301	44
P1	0-4"	4.64	37.0	158	2599	374	36
P2	4-8"	3.98	18.8	128	1869	376	40
Q1	0-4"	2.90	27.9	54	684	223	38
Q2	4-8"	2.73	34.0	66	798	319	48
R1	0-4"	3.42	64.0	184	2280	319	48
R2	4-8"	3.33	21.4	170	1276	312	52

With the extremely low pH values resulting from the oxidation of pyrite, many elements are mobilized or put into soil solution.

Aluminum, iron and manganese will attain toxic levels for plants at pH values below 4.0. These elements will increase the electrical conductance of soil solution but high levels of calcium, magnesium and sodium will also affect conductance in the same manner. At extremely low pH values, aluminum and iron are at concentrations that inhibit seedling germination and prohibit root extension (see Table 14). Extractable aluminum increases significantly as the pH drops below 4.0. Concentrations of iron and manganese also increase below pH 4.0.

One of the primary reasons that double acid phosphorus determinations were discontinued on this project was that high iron concentrations from samples originating in reduced environments interfered with the color development in this procedure.

Copper values range from 0.6 PPM at pH 5.2 to 2.2 PPM at pH 2.2. Zinc values range from 1.7 PPM at pH 5.4 to 14.4 PPM at pH 2.66. This indicates that both elements become more mobile at lower pH's. Extremely low pH ranges could mobilize significant levels of these ions to present toxicity problems for plants.

Sufficient neutralizers added to this disposal area will prevent many of the previously mentioned problems associated with extreme soil acidity. Mulching to control erosion and establishment of legumes in the seeding mixture will establish sustaining vegetation.

Disposal Area 1503

Disposal area 1503 is adjacent to disposal area 1504 on the northern edge. The graded fill material has basically the same origin as the fill in disposal area 1504 - typical Eutaw beds and the McShan formation.

TABLE 14

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF
DISPOSAL AREA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
A1	0–4"	6.11	<0.20	22	.9	7.3	49
A2	4–8"	5.07	.37	13	1.1	3.8	28
B1	0–4"	6.43	<0.20	18	.8	3.3	29
B2	4–8"	5.54	<0.20	11	.9	1.7	18
C1	0–4"	6.56	<0.20	17	1.1	3.1	23
C2	4–8"	6.06	<0.20	8	1.1	2.6	13
D1	0–4"	5.29	<0.20	28	.6	3.4	27
D2	4–8"	5.18	<0.20	26	1.0	2.6	29
E1	0–4"	4.48	1.3	24	1.0	2.4	67
E2	4–8"	4.10	1.1	38	.9	3.7	39
F1	0–4"	2.71	4.1	16	.9	4.1	266
F2	4–8"	2.65	6.5	27	1.0	4.1	229
G1	0–4"	2.51	4.6	29	.9	6.0	508
G2	4–8"	2.61	4.3	27	1.6	16.3	357

TABLE 14

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF
DISPOSAL AREA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	PPM Cu	PPM Zn	PPM Fe
H1	0-4"	3.01	4.2	9	1.0	6.4	155
H2	4-8"	3.11	3.4	12	.9	3.6	137
I1	0-4"	4.75	<.20	22	1.1	10.6	89
I2	4-8"	3.64	1.4	26	.8	3.3	88
J1	0-4"	2.66	10.7	108	1.5	14.4	1073
J2	4-8"	4.72	8.2	74	1.6	8.2	883
K1	0-4"	2.41	10.9	102	1.8	10.2	2156
K2	4-8"	2.42	8.6	66	2.2	8.4	1642
L1	0-4"	2.62	5.2	16	.8	13.7	273
L2	4-8"	2.42	4.8	18	.9	4.7	323
M1	0-4"	2.33	7.4	68	1.2	6.7	687
M2	4-8"	2.23	5.8	62	1.5	6.7	815
N1	0-4"	3.39	2.0	40	.6	2.4	98
N2	4-8"	3.07	2.0	69	.8	27.4	143

TABLE 14

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
H1	0-4"	3.01	4.2	9	1.0	6.4	155
H2	4-8"	3.11	3.4	12	.9	3.6	137
I1	0-4"	4.75	<.20	22	1.1	10.6	89
I2	4-8"	3.64	1.4	26	.8	3.3	88
J1	0-4"	2.66	10.7	108	1.5	14.4	1073
J2	4-8"	4.72	8.2	74	1.6	8.2	883
K1	0-4"	2.41	10.9	102	1.8	10.2	2156
K2	4-8"	2.42	8.6	66	2.2	8.4	1642
L1	0-4"	2.62	5.2	16	.8	13.7	273
L2	4-8"	2.42	4.8	18	.9	4.7	323
M1	0-4"	2.33	7.4	68	1.2	6.7	687
M2	4-8"	2.23	5.8	62	1.5	6.7	815
N1	0-4"	3.39	2.0	40	.6	2.4	98
N2	4-8"	3.07	2.0	69	.8	27.4	143

TABLE 14

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1504

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM			
				Mn	Cu	Zn	Fe
O1	0-4"	3.45	2.5	37	1.6	4.8	157
O2	4-8"	3.23	3.6	26	1.2	13.7	117
P1	0-4"	4.64	1.2	28	1.5	5.2	171
P2	4-8"	3.98	2.4	35	1.6	4.5	209
Q1	0-4"	2.90	5.3	29	1.0	3.4	187
Q2	4-8"	2.73	5.7	43	1.2	5.7	235
R1	0-4"	3.42	1.9	40	.9	9.7	195
R2	4-8"	3.33	2.8	45	.9	13.1	151

The general condition of the disposal area during sampling revealed a wide range of plant establishment. On our first visitation to the site a significant portion of plant cover was dying. Additional liming near sample point I helped maintain cover and hold the vegetation in. Other surface liming was completed after we sampled this disposal area and some of the results may differ from a more recent sampling. The surface liming is helping to revive vegetation on disposal area 1503, reducing chances of severe erosion as found on 1504. The sampling depths were generally the same except more samples were taken on the morphologic break.

Table 15 is the Acid-Base Account of disposal area 1503. Most of the sampling was completed before the area was relimed. Unreacted lime is indicated in the Fizz column in Table 15.

In most instances, surface samples that show deficiencies of approximately 5 tons/1,000 tons calcium carbonate equivalent reveal dead vegetation or severely stressed vegetation. Sampling point F1 shows a deficiency of 2.03 tons/1,000 tons calcium carbonate equivalent and plants were showing some stress. Comparing this to sampling point G1, healthy vegetation and an excess of neutralizers are present in the 0-4 inch layer. Sample G2, a 4-8 inch sampling, reveals potentially toxic material but vegetation is sustaining and will thrive if pyrite materials are not "plowed up" or brought back to the surface.

Sampling points I, J, L and M are sustaining vegetation while K is showing stressed and dying vegetation. Sample H1 has dead plants and is showing potentially toxic materials on the surface. Liming did occur after sampling and some of these sampling points show vegetation returning - some are invading species which will be discussed in the vegetation section.

TABLE 15

ACID-BASE ACCOUNT OF DA 1503

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
A1	0-4"	2.50	None	2.5Y5/4	.2033	6.35	-4.15	10.50	
A2	4-8"	2.48	None	2.5Y5/4	.3671	11.47	-7.84	19.31	
B1	0-4"	5.67	None	2.5Y5/4	.1146	3.58	5.54		1.96
B2	4-8"	2.96	None	2.5Y5/4	.1186	3.71	-1.84	5.55	
C1	0-4"	3.53	None	2.5Y5/4	.1652	5.16	-1.38	6.54	
C2	4-8"	2.78	None	2.5Y6/4	.1954	6.11	-3.69	9.80	
D1	0-4"	2.36	None	2.5Y6/4	.2695	8.42	-5.08	13.50	
D2	4-8"	2.33	None	2.5Y5/4	.9203	28.76	-8.31	37.07	
E1	0-4"	2.67	None	2.5Y6/4	.2068	6.46	-5.31	11.77	
E2	4-8"	2.67	None	2.5Y6/4	.3062	9.57	-5.54	15.11	
F1	0-4"	3.76	None	2.5Y6/4	.0943	2.95	.92	2.03	
F2	4-8"	6.30	None	2.5Y6/4	.2175	6.80	5.77	1.03	
G1	0-4"	6.86	Moderate	2.5Y6/4	.0832	2.60	12.10		9.50
G2	4-8"	3.48	None	10YR6/6	.1292	4.04	-1.64	5.68	

TABLE 15

ACID-BASE ACCOUNT OF DA 1503

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
H1	0-4"	3.84	Slight	2.5Y6/4	.1260	3.93	-1.13	5.07	
H2	4-8"	3.23	None	2.5Y6/4	.2413	7.54	-3.69	11.23	
H3	16-18"	4.05	None	2.5Y7/2	.0486	1.52	- .21	1.73	
I1	0-4"	6.76	Strong	10YR6/6	.0521	1.63	21.03		19.40
I2	4-8"	3.42	Slight	10YR6/6	.1111	3.47	-1.85	5.32	
J1	0-4"	6.17	Moderate	10YR6/3	.1123	3.51	12.92		9.41
J2	4-8"	2.98	None	2.5Y7/4	.0828	2.59	-2.87	5.46	
K1	0-4"	4.02	Slight	2.5Y6/4	.1598	4.99	1.44	3.55	
K2	4-8"	2.64	None	2.5Y6/4	.2463	7.70	-5.74	13.44	
K3	8-12"	3.48	None	2.5Y6/2	.2417	7.55	-1.85	9.40	
L1	0-5"	6.20	Slight	5Y5/2	.1282	4.01	12.67		8.66
L2	5-13"	3.8	None	5Y5/2	.1543	4.82	-3.05	7.87	
L3	13-17"	4.0	None	5Y5/2	.4926	15.39	-1.64	17.03	
M1	0-5"	6.7	Moderate	2.5Y6/4	.2731	8.53	37.32		28.79
M2	5-10"	3.5	None	2.5Y6/4	.2126	6.64	-1.64	8.28	

Macronutrients results are similar to results on disposal area 1504 (see Table 16). Potassium is low on some samples but ranged to high and very high availability on most samples. Calcium ranged from medium to very high as the plant available form. Magnesium ranged from high to very high and sodium is adequate for plant nutrition. Phosphorus values are again high to very high even at low pH levels.

Exchangeable aluminum, double acid extractable iron and manganese generally increased in concentrations as the pH decreased. Aluminum ranged from less than 0.2 meq/100g at pH 6.17 to 8.6 meq/100g at pH 2.52. Iron and manganese generally were more mobile at lower pH values. Sample G1 illustrates the immobilization of aluminum when adequate neutralizers are added to the soil with many other micronutrients decreasing in mobility as pH increases (see Table 17).

Copper concentrations are similar to the values reported in disposal area 1504. Zinc values are consistently higher in this disposal area suggesting that additions of zinc may have been made during initial fertilization. Micronutrient values are difficult to interpret for a broad category of plants but toxicities occur at extremely low pH values. These toxicities are corrected by liming soils to optimum levels.

Aluminum sulfate minerals are present on extremely acid soil in this disposal area. Gypsum, a calcium sulfate neutral salt, is present where reliming of the surface was completed.

Disposal Area 1704

This disposal area was selected for sampling based on sustaining vegetation and apparent low acid producing potential. The study area is

TABLE 16

NUTRIENT STATUS REPORT - DISPOSAL AREA 1503

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
A1	0-4"	2.36	51.0	36	1527	433	40
A2	4-8"	2.21	19.0	60	4058	567	34
B1	0-4"	4.13	54.5	196	7911	462	46
B2	4-8"	2.75	17.5	170	2804	421	44
C1	0-4"	3.24	131.8	150	5358	426	32
C2	4-8"	2.56	35.5	132	2964	617	48
D1	0-4"	2.34	32.5	50	2376	326	32
D2	4-8"	2.35	29.3	48	2348	488	28
E1	0-4"	2.32	14.0	38	2485	611	34
E2	4-8"	2.58	16.0	76	3465	627	42
F1	0-4"	3.63	23.5	194	3260	533	56
F2	4-8"	4.92	118.0	270	9279	453	48
G1	0-4"	6.70	121.0	430	10419	462	40
G2	4-8"	3.34	56.0	154	2120	358	32

TABLE 16

NUTRIENT STATUS REPORT - DISPOSAL AREA 1503

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
H1	0-4"	3.36	21.0	134	2895	588	39
H2	4-8"	3.01	27.0	196	3762	757	47
H3	16-18"	3.71	39.0	215	1322	485	31
I1	0-4"	6.65	130.0	564	15549	392	43
I2	4-8"	3.26	54.0	162	2143	401	28
J1	0-4"	5.28	42.0	476	10602	426	38
J2	4-8"	2.86	42.6	190	1596	221	25
K1	0-4"	3.34	46.0	146	5677	793	54
K2	4-8"	2.52	33.0	42	1801	852	36
K3	8-12"	3.35	69.0	130	1596	533	31
L1	0-5"	4.5	48	130	12798	156	20
L2	5-13"	2.8	12	62	2430	302	16
L3	13-17"	3.2	8	88	1782	772	16
M1	0-5"	6.2	53	254	23760	610	30
M2	5-10"	3.0	8	126	3618	600	24

TABLE 17

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1503

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	PPM Cu	PPM Zn	PPM Fe
A1	0-4"	2.36	5.0	74	.8	23.4	366
A2	4-8"	2.21	7.3	107	1.5	21.3	626
B1	0-4"	4.13	.46	67	1.5	44.0	192
B2	4-8"	2.75	3.6	55	1.2	5.8	258
C1	0-4"	3.24	3.1	81	1.0	4.1	252
C2	4-8"	2.56	6.2	121	1.1	28.2	270
D1	0-4"	2.34	5.3	66	.9	6.5	565
D2	4-8"	2.35	6.4	99	1.2	9.1	1200
E1	0-4"	2.32	6.3	136	1.3	48.9	350
E2	4-8"	2.58	5.2	151	1.2	10.8	365
F1	0-4"	3.63	1.1	96	.8	4.9	126
F2	4-8"	4.92	< .20	81	1.1	57.8	145
G1	0-4"	6.70	< .20	54	1.2	10.4	123
G2	4-8"	3.34	2.9	54	3.0	4.9	170

TABLE 17

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1503

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
H1	0-4"	3.36	4.7	141	1.3	14.8	207
H2	4-8"	3.01	5.4	200	1.6	7.9	283
H3	16-18"	3.71	2.1	84	1.4	6.4	494
I1	0-4"	6.65	<.20	49	1.1	6.7	35
I2	4-8"	3.26	4.0	50	2.5	5.8	152
J1	0-4"	5.28	<.20	54	1.5	16.1	233
J2	4-8"	2.86	4.6	28	1.5	5.5	241
K1	0-4"	3.34	3.3	125	2.0	10.5	335
K2	4-8"	2.52	8.6	157	1.0	11.4	491
K3	8-12"	3.35	3.4	97	1.4	10.2	405
L1	0-5"	4.5	<.20	17	.7	3.7	163
L2	5-13"	2.8	4.6	42	.7	4.0	20[illegible]
L3	13-17"	3.2	2.8	123	.5	7.3	446
M1	0-5"	6.2	<.20	81	.7	19.3	167
M2	5-10"	3.0	3.7	84	.6	4.[illegible]	15[illegible]

located just south of the Highway 30 bridge near Paden, Mississippi (see Figure 11). This was one of the smallest disposal areas sampled in this study but offered a range of different types of materials for study. Examination of this disposal area in the field revealed that most of the surface was mixed with alluvium, typical Eutaw and "McShan", dominated in the root growth zone by alluvium.

Table 18 shows the total sulfur concentrations are low throughout the disposal area, thus extreme acidity is absent except in a few scattered spots. An excavated pit (1704 - Pit 1) represents one of the extremely acid points and is discussed in the soil profile section.

Acid-Base Accounting (Table 18) reveals that many surface samples contain excess neutralizers indicating initial and reliming efforts were successful.

Table 19 shows that soils are generally high in phosphorus in the surface layer drawing attention to initial fertilization. Potassium values range from high to very high in most instances. Available calcium is in the medium to high range with some very high values as shown on samples G1 and F1. Magnesium concentrations are medium to very high and sodium is adequate for plant nutrition, but not excessive causing salt toxicity problems. Micronutrient concentrations generally increase as pH decreases. This is true also with KCl - extractable aluminum (see Table 20).

Plant growth on this disposal area is good and recovered in most instances after being burned over, except where extremely acid or marginal acid-toxic soils were present. Root penetration is good (Appendix D) even though the clay content is higher than values found in the other areas. Some subsoils contained firm, compacted fragments which were not

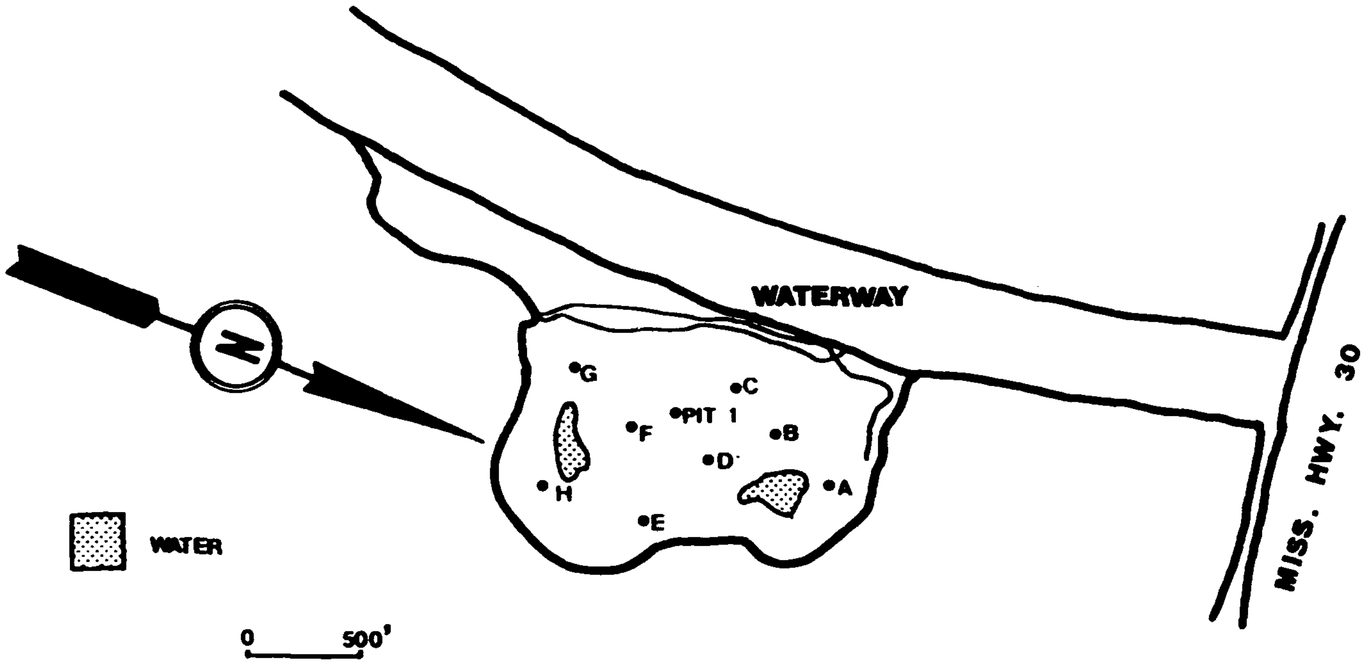

Figure 11. Sample locations on disposal area 1704

TABLE 18

ACID-BASE ACCOUNT OF DA 1704

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
A1	0-4"	6.85	None	2.5Y6/4	.0105	0.33	4.10		3.77
A2	4-8"	4.45	None	2.5Y6/4	.0115	0.36	-.47	.83	
B1	0-6"	4.98	None	2.5Y6/4	.0132	0.41	1.52		1.11
B2	6-12"	4.74	None	2.5Y7/4	.0165	0.52	-.82	1.34	
B3	2-6"	4.80	None	2.5Y6/2	.0327	1.02	1.99		.97
C1	0-4"	6.47	Slight	2.5Y6/2	.0232	0.73	6.45		5.72
C2	4-8"	4.75	None	5Y6/2	.0298	0.93	.59		0.34
D1	0-4"	4.36	None	2.5Y6/4	.0134	0.42	-.59	1.01	
D2	4-8"	4.78	None	5Y6/3	.0120	0.38	-.12	0.50	
E1	0-4"	5.54	None	5Y6/3	.0105	0.33	1.06		0.73
E2	4-8"	4.87	None	5Y6/3	.0115	0.36	.12		0.24
F1	0-4"	[illegible].50	Slight	%y5/1	.0245	0.77	18.41		17.64

TABLE 18

ACID-BASE ACCOUNT OF DA 1704

Divide Section - Tennessee Tombigbee Waterway

						$CaCO_3$ Equivalent Tons/1000 Tons Material			
Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
F2	4-8"	5.62	None	5Y6/1	.0195	0.61	.94		0.33
G1	0-4"	7.44	Moderate	5Y6/3	.0137	0.43	28.63		28.20
G2	4-8"	6.63	None	5Y6/3	.0121	0.38	3.29		2.91
H1	0-4"	5.03	None	5Y6/3	.0149	0.47	.47		0.00
H2	4-8"	4.59	None	5Y6/3	.0181	0.57	-.23	0.80	

TABLE 19

NUTRIENT STATUS REPORT - DISPOSAL AREA 1704

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
A1	0-4"	6.2	55	238	3726	298	20
A2	4-8"	3.9	11	138	1242	276	18
B1	0-6"	4.1	32	158	2862	292	22
B2	6-12"	3.9	40	208	3024	896	62
B3	2-6"	3.5	9	216	1836	470	24
C1	0-4"	4.5	37	200	6750	270	26
C2	4-8"	3.4	14	114	864	222	20
D1	0-4"	4.0	38	220	1836	324	24
D2	4-8"	3.4	21	184	1026	406	24
E1	0-4"	4.1	18	234	1512	346	16
E2	4-8"	3.8	14	156	1080	356	26
F1	0-4"	7.1	31	198	8694	308	18

TABLE 19

NUTRIENT STATUS REPORT - DISPOSAL AREA 1704

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Lbs./1000 Tons Ca	Lbs./1000 Tons Mg	Lbs./1000 Tons Na
F2	4-8"	3.8	11	154	1674	372	20
G1	0-4"	7.1	60	400	17550	372	20
G2	4-8"	5.9	26	140	4266	324	26
H1	0-4"	4.1	34	252	4212	394	20
H2	4-8"	3.6	12	198	1242	356	20

TABLE 20

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1704

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	PPM Cu	PPM Zn	PPM Fe
A1	0-4"	6.2	< .20	30	1.1	3.8	295
A2	4-9"	3.9	2.47	35	1.0	3.2	275
B1	0-6"	4.1	2.00	56	1.5	3.3	414
B2	6-12"	3.9	5.43	60	4.7	12.3	1562
B3	2-6"	3.5	3.91	40	2.0	15.4	264
C1	0-4"	4.5	< .20	28	0.8	3.4	130
C2	4-8"	3.4	3.51	20	0.7	3.7	103
D1	0-4"	4.0	2.69	65	1.1	4.0	382
D2	4-8"	3.4	4.36	65	1.4	4.1	312
E1	0-4"	4.1	1.80	47	0.8	2.4	191
E2	4-8"	3.8	3.22	48	0.8	2.6	182
F1	0-4"	7.1	< .20	19	0.6	2.9	96

TABLE 20

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1704

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
F2	4-8"	3.8	1.38	16	0.5	2.6	50
G1	0-4"	7.1	< .20	41	0.8	4.7	145
G2	4-8"	5.9	< .20	50	0.9	1.9	193
H1	0-4"	4.1	0.60	25	0.9	3.4	177
H2	4-8"	3.6	3.05	28	0.9	6.7	134

continuous, thus allowing roots to penetrate. This is one of the best revegetated disposal areas examined during the study.

Disposal Area 1204

This disposal area is newly constructed and represents a change in liming in the divide section of the waterway. Disposal areas 1204 and 1203 were deposited at about the same time interval. With an increased liming rate of 12 tons/acre and a change in "plating" of less toxic material, successful revegetation over the major portion of disposal area 1204 is evident.

In Table 21, Acid-Base Account of 1204, the upper sampling point (0-4" layer generally) has adequate neutralizers to offset acidity that can be produced by pyrite oxidation. (For sample locations, see Figure 12). Sample J1 is the exception and shows potentially toxic materials at the surface and dead vegetation. This area should immediately be limed and mulched to the acid-base account to prevent erosion. Many of the second sampling depths show acid toxic material at the 4-8 inch layer. Deep disturbance beyond 4-5 inches should be avoided in these instances to prevent pyritic materials from reaching the surface and initiating oxidation. Surface liming is adequate to suppress oxidation in most cases if surface erosion does not expose pyritic materials, rekindling oxidation. Sample H3 is unusual showing a high excess in neutralizers at the 12-15 inch depth. Conversations with Corps personnel indicated that a large portion of lime was graded in the fill at this point during construction.

Scattered spots of dead vegetation were observed but the area was recently limed thus allowing new seedlings to germinate and revive stressed vegetation. Vegetation evaluations from transects are reported in the vegetation section.

TABLE 21

ACID-BASE ACCOUNT OF DA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
A1	0-4"	6.34	Slight	5Y5/3	.0425	1.33	11.50		10.17
A2	4-8"	3.47	None	5Y5/4	.0565	1.77	- .15	1.92	
B1	0-4"	6.79	Moderate	5Y5/4	.0270	.84	10.89		10.05
B2	4-8"	3.23	None	5Y6/3	.0792	2.48	- .46	2.94	
C1	0-5"	6.71	Moderate	5Y5/2	.0626	1.96	13.65		11.69
C2	5-10"	3.63	None	5Y5/3	.0842	2.63	- .46	3.09	
D1	0-5"	6.70	Slight	5Y5/1	.0503	1.57	12.50		10.93
D2	5-10"	3.96	None	5Y5/3	.1098	3.43	1.07	2.36	
E1	0-8"	6.55	Slight	5y5/2	.0559	1.75	10.58		8.83
E2	8-14"	3.86	None	5Y5/3	.0975	3.05	- .15	3.20	
F1	0-4"	7.26	Strong	5Y5/1	.0611	1.91	44.01		42.10
F2	4-8"	4.31	None	5Y5/2	.0406	1.27	1.07	.20	
G1	0-6"	6.68	Slight	5Y5/3	.2598	8.12	11.59		3.47

TABLE 21

ACID-BASE ACCOUNT OF DA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
G2	6-12"	4.06	None	5Y5/3	.2864	8.95	- .92	8.03	
G3	12-16"	4.86	None	5Y5/2	.2120	6.63	2.91	3.72	
H1	0-7"	7.26	Strong	5Y5/2	.0664	2.08	23.19		21.11
H2	7-12"	4.00	None	5Y5/3	.0886	2.77	.92	1.85	
H3	12-15"	7.33	Very Strong	5Y7/2	.0711	2.22	292.51		290.29
I1	0-4"	5.21	None	5Y6/2	.0597	1.87	2.44		.57
I2	4-8"	3.96	None	2.5Y6/4	.0772	2.41	- .31	2.72	
J1	0-4"	3.60	None	5Y5/3	.2161	6.75	-2.75	9.50	
J2	4-8"	5.45	None	5Y5/3	.1046	3.27	2.14	1.13	
K1	0-4"	6.61	None	5Y5/3	.1126	3.52	8.85		5.33
K2	4-8"	5.05	None	5Y5/3	.1205	3.77	2.75	1.02	
L1	0-4"	6.19	Slight	5Y6/2	.0999	3.12	6.43		3.31
L3	9-13"	3.80	None	5Y5/3	.2240	7.00	- .92	7.92	

TABLE 21

ACID-BASE ACCOUNT OF DA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
M1	0-4"	7.14	Slight	5Y5/2	.0254	.79	14.09		13.30
M2	4-8"	5.10	None	5Y6/1	.0234	.73	.92		.19
N1	0-4"	6.98	Moderate	5Y5/3	.0407	1.27	14.70		13.43
N2	4-8"	4.88	None	5Y6/2	.0277	.87	1.53		.66
O1	0-5"	6.84	Moderate	5Y5/2	.0819	2.56	18.99		16.43
O2	5-10"	4.80	None	5Y5/2	.0372	1.16	.61	.55	
P1	0-4"	5.87	None	5Y5/3	.1788	5.59	4.90	.69	
P2	4-8"	3.78	Slight	5Y5/3	.2005	6.27	0.00	6.27	
Q1	0-4"	5.88	Slight	5Y5/3	.2111	6.60	7.66		1.06
Q2	4-9"	3.02	None	5Y6/4	.1754	5.48	-2.11	7.59	
Q3	9-13"	3.66	None	5Y6/4	.2269	7.09	.23	6.86	
R1	0-4"	6.58	Slight	5Y5/2	.0352	1.10	8.21		7.11
R2	4-8"	4.46	None	5Y5/2	.0329	1.03	.70	.33	

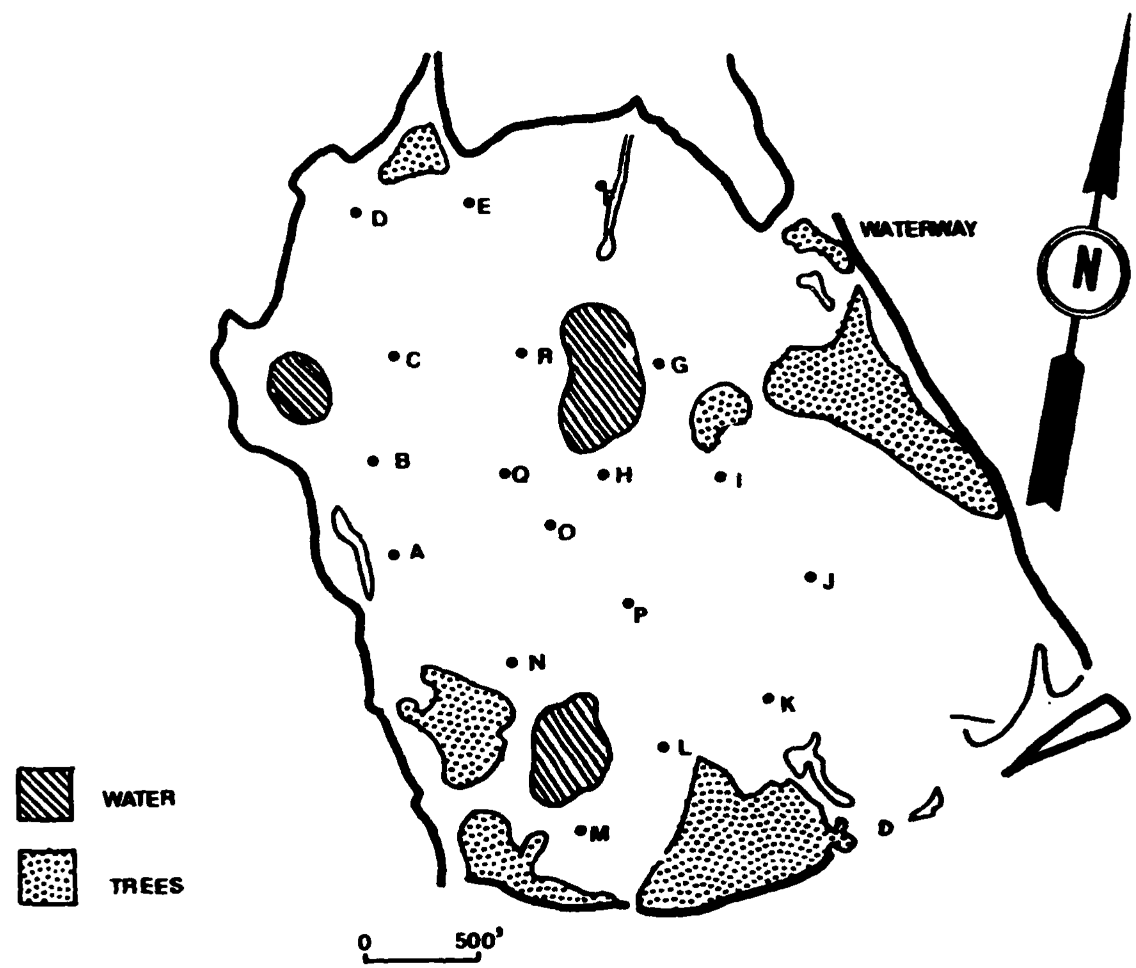

Figure 12. Sample locations on disposal area 1204

From field notes and sampling logs in Appendix D, root penetration stopped where the lower layer is potentially toxic. Roots are concentrated in layers where neutralizers are in excess. As the lime reacts to completion and oxidation subsides, roots should have ample growth zone to sustain vegetation. Table 21, sample L2, shows no roots present in this layer - this sample is potentially toxic.

Nutrient status (Table 22) shows that potassium values are medium to very high throughout the disposal area except for sample C2 which is low. Available calcium is high to very high in the surface layers and ranges from medium to high in the 4 to 8 inch layer. Magnesium is medium to very high concentrations in most samples. Sodium is adequate for plant nutrition.

As discussed in previous disposal areas, the KCl-extractable aluminum increases in concentration with decreasing pH (Table 23). Manganese values fluctuate with pH but do not show a definite trend as do the aluminum concentrations. Some surface samples with high values in manganese have recently been limed and neutralizers have not reacted sufficiently to immobilize manganese and other micronutrients. Iron values are lower with high pH values with the mobility of iron decreasing as the pH approaches neutrality. Sample H3 has pH of 7.5 with 1 ppm iron and reduced levels of the other micronutrients. This illustrates the effect of increasing pH on mobility of these elements.

This disposal area has good vegetative cover with the exception of the area represented by sample J1. A few points with deep sand or loamy sand may present moisture stress problems in unusually dry years but this is not a widespread problem because most of the fill contains fine textured (mudstone) lenses that break continuity, increasing moisture holding capacity.

TABLE 22

NUTRIENT STATUS REPORT - DISPOSAL AREA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
A1	0-4"	5.1	59	318	8586	275	38
A2	4-8"	2.8	16	166	1944	227	18
B1	0-4"	5.7	13	240	7344	205	20
B2	4-8"	3.0	37	152	1674	113	16
C1	0-5"	6.1	29	150	9234	135	26
C2	5-10"	2.7	11	50	1998	130	20
D1	0-5"	5.7	55	156	7614	140	20
D2	5-10"	3.0	51	100	1296	81	20
E1	0-8"	5.5	2	260	7668	205	24
E2	8-14"	2.9	71	174	3294	281	26
F1	0-4"	7.1	75	366	20196	297	32
F2	4-8"	3.9	14	186	2052	167	24
G1	0-6"	6.C	40	412	10044	529	46

TABLE 22

NUTRIENT STATUS REPORT - DISPOSAL AREA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
G2	6-12"	3.0	9	274	4590	621	42
G3	12-16"	3.4	9	272	3464	567	48
H1	0-7"	7.0	28	296	14958	324	28
H2	6-12"	3.4	20	214	2862	351	28
H3	12-15"	7.5	18	190	28080	302	34
I1	0-4"	3.7	37	272	3348	383	38
I2	4-8"	3.4	32	200	2268	432	18
J1	0-4"	3.3	18	132	2214	205	18
J2	4-8"	3.5	55	308	6534	281	22
K1	0-4"	5.6	19	328	8154	513	24
K2	4-8"	4.3	21	316	3834	556	20
L1	0-4"	3.9	45	222	5184	367	44
L2	4-9"	2.7	24	116	2754	567	36

TABLE 22

NUTRIENT STATUS REPORT - DISPOSAL AREA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
L3	9-13"	2.9	14	302	3402	610	32
M1	0-4"	5.9	75	216	8370	178	22
M2	4-8"	3.1	40	90	918	97	20
N1	0-4"	6.0	75	336	11232	400	24
N2	4-8"	3.6	12	174	1404	324	20
O1	0-5"	5.9	29	320	12798	367	36
O2	5-10"	3.6	24	264	2970	410	38
P1	0-4"	4.0	35	434	6156	535	38
P2	4-8"	2.9	24	350	4536	518	32
Q1	0-4"	3.9	40	472	8262	680	48
Q2	4-9"	2.6	21	328	4266	616	42
Q3	9-13"	3.2	14	404	3618	605	42
R1	0-4"	5.9	38	146	5994	173	18
R2	4-8"	3.0	18	170	3402	346	22

TABLE 23

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
A1	0-4"	5.1	< .20	52	.9	2.9	167
A2	4-8"	2.8	5.78	44	.5	1.8	186
B1	0-4"	5.7	< .20	26	.5	1.5	164
B2	4-8"	3.0	1.78	19	.5	1.4	180
C1	0-5"	6.1	< .20	11	.5	2.6	221
C2	5-10"	2.7	1.96	12	.4	2.2	231
D1	0-5"	5.7	< .20	17	.5	1.6	179
D2	5-10"	3.0	1.25	13	.4	6.7	217
E1	0-8"	5.5	< .20	26	.8	7.7	220
E2	8-14"	2.9	2.22	44	.8	9.4	275
F1	0-4"	7.1	< .20	28	.9	3.4	168
F2	4-8"	3.4	1.38	13	.9	1.9	197
G1	0-6"	6.0	< .20	127	1.3	3.6	562

TABLE 23

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM			
				Mn	Cu	Zn	Fe
G2	6-12"	3.0	2.78	210	1.6	5.3	615
G3	12-16"	3.4	1.87	193	.4	1.9	539
H1	0-7"	7.0	< .20	40	.5	1.6	316
H2	7-12"	3.4	1.96	52	.4	2.5	287
H3	12-15"	7.5	< .20	25	.4	.2	1
I1	0-4"	3.7	1.00	89	.5	1.9	143
I2	4-8"	3.4	2.33	89	.5	1.6	140
J1	0-4"	3.3	4.07	26	.4	2.2	196
J2	4-8"	3.5	2.07	34	.7	2.4	205
K1	0-4"	5.6	< .20	122	.4	1.4	428
K2	4-8"	4.3	.40	171	.3	1.3	525
L1	0-4"	3.9	.98	74	.6	6.2	166
L2	4-9"	2.7	5.43	84	.5	4.1	326

TABLE 23

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1204

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
L3	9-13"	2.9	2.62	75	.5	4.4	520
M1	0-4"	5.9	< .20	10	.4	8.2	141
M2	4-8"	3.1	1.00	12	.1	.9	203
N1	0-4"	6.1	< .20	66	1.0	9.2	279
N2	4-8"	3.8	1.53	75	.1	1.1	263
O1	0-5"	5.9	< .20	64	.4	2.4	342
O2	5-10"	3.6	1.05	83	.5	5.0	411
P1	0-4"	4.9	.62	94	.9	4.3	446
P2	4-8"	2.9	3.40	93	.9	6.1	405
Q1	0-4"	3.9	.38	83	1.1	5.1	352
Q2	4-9"	2.6	3.29	137	.7	4.5	395
Q3	9-13"	3.2	1.80	125	.8	3.4	431
R1	0-4"	5.9	< .20	22	.5	8.5	203
R2	4-8"	3.9	1.31	50	.8	4.4	[illegible]

Disposal Area 1203

Figure 13 shows the sampling points on disposal area 1203. Laboratory data reported are essentially the same as found on disposal area 1204. Sufficient neutralizers are present in the surface layer to offset oxidation by pyrite. Fertility status is high for the basic plant nutrient elements. Root penetration was observed to eight or more inches at many sampling points. Roots were not inhibited unless they penetrated into toxic or potentially toxic zone as illustrated in sample 02, where no roots were present in potentially toxic material.

Table 24 shows a general trend that is also found in disposal area 1204. Surface layers are adequately limed to counterbalance acidity but the 4 to 8 inch layers on many samples show acid toxic soil.

This disposal area has good vegetation with scattered spots showing plant mortality. This is the result of acid toxic substances on the surface but spot surface treatments with lime will prevent erosional gullies from forming.

Phosphorus values are high to very high at the surface resulting from fertilization (Table 25). Generally low levels of phosphorus in the second sampling depth indicate a different point of origin for this material than for the material arising from typical Eutaw beds.

Extractable potassium concentrations are high to very high in most samples including samplings at deeper depths. Higher potassium and phosphorus values at the surface show initial fertilization has resulted in higher values than at lower depths. Potassium values are higher in the disposal areas constructed from typical Eutaw beds.

Magnesium is high to very high in all samples throughout this disposal area. Magnesium concentrations as well as potassium concentrations are high in most samples originating in the typical Eutaw beds.

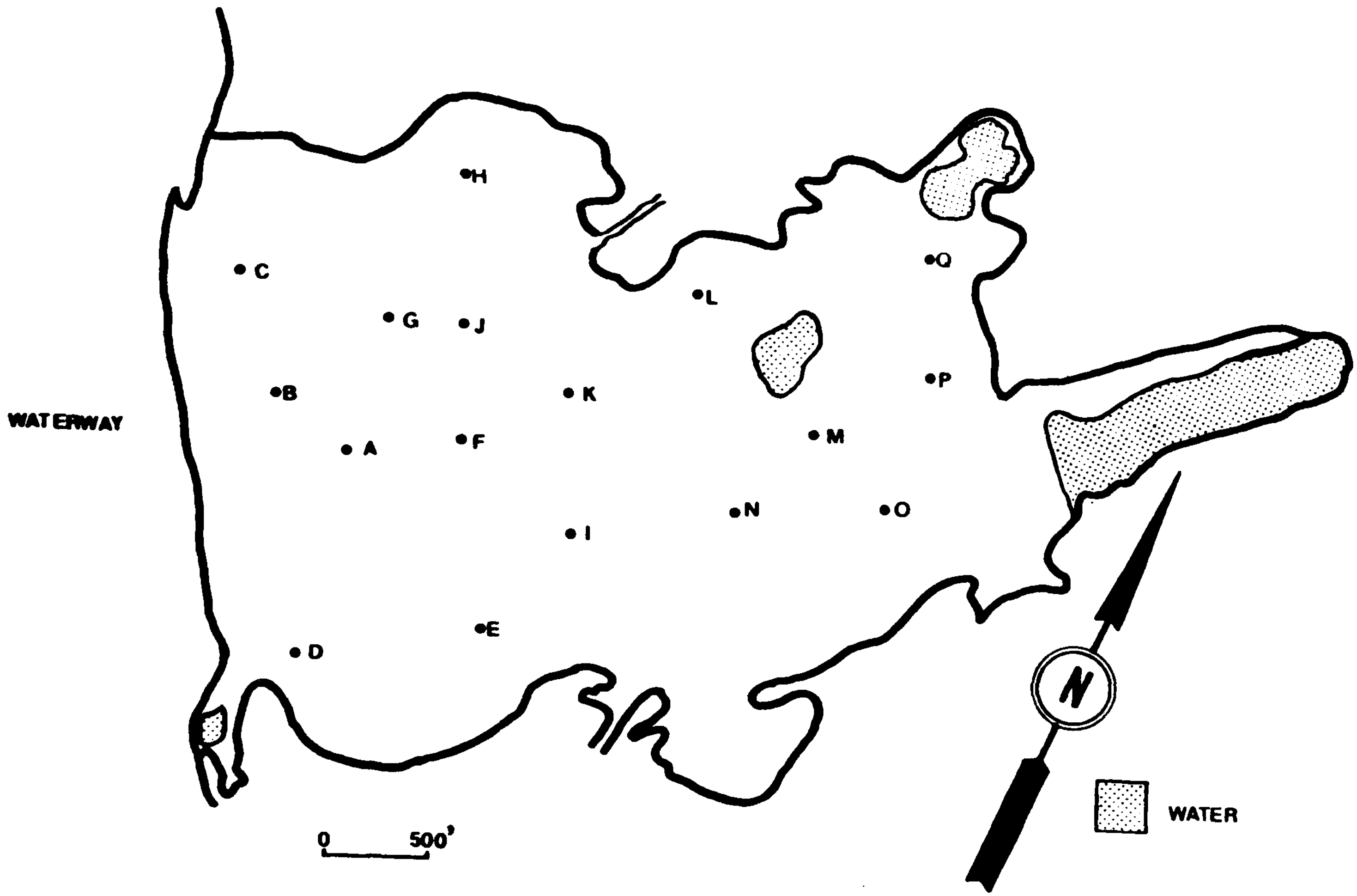

Figure 13. Sample locations on disposal area 1203

TABLE 24

ACID-BASE ACCOUNT OF DA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
A1	0-4"	6.55	Moderate	5Y6/2	.1354	4.23	22.06		17.83
A2	4-8"	3.54	None	5Y6/3	.2929	9.15	-4.46	13.61	
B1	0-3"	7.22	Slight	5Y6/3	.0503	1.57	16.43		14.86
B2	3-8"	5.82	None	5Y6/3	.0087	.27	1.64		1.37
C1	0-6"	7.27	Slight	5Y6/2	.1124	3.51	18.31		14.80
C2	6-10"	3.80	None	2.5Y6/4	.1425	4.45	1.07	3.38	
D1	0-5"	7.15	Moderate	5Y6/4	.0633	1.98	18.54		16.56
D2	5-9"	4.77	None	5Y6/3	.0274	.86	1.53		.67
E1	0-5"	5.92	None	5Y6/3	.0474	1.48	4.22		2.74
E2	5-9"	5.01	None	5Y6/2	.0634	1.98	.23	1.75	
F1	0-4"	6.90	Strong	5Y6/3	.0797	2.49	26.76		24.27
F2	4-8"	3.73	None	2.5Y6/4	.0920	2.88	-1.41	4.29	
G1	0-4"	7.42	Moderate	5Y5/2	.0492	1.54	16.40		14.86

TABLE 24

ACID-BASE ACCOUNT OF DA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
G2	4-8"	3.62	None	5Y6/4	.0354	1.11	0.00	1.11	
H1	0-4"	4.59	None	5Y5/3	.1282	4.01	1.64	2.37	
H2	4-8"	3.41	None	5Y6/3	.1399	4.37	-3.05	7.42	
I1	0-4"	7.51	Strong	2.5Y6/4	.0298	.93	37.95		37.02
I2	4-8"	5.90	None	5Y6/2	.0569	1.78	4.69		2.91
J1	0-4"	7.27	Strong	5Y6/2	.0377	1.18	28.11		26.93
J2	4-8"	3.58	None	5Y6/4	.0316	.99	- .23	1.22	
K1	0-4"	6.20	Moderate	5Y5/3	.0495	1.55	12.88		11.33
K2	4-8"	2.87	None	2.5Y6/4	.0223	.70	- .47	1.17	
L1	0-4"	6.12	Slight	5Y5/3	.0763	2.38	6.79		4.41
L2	4-8"	3.24	None	2.5Y6/4	.1582	4.94	-1.41	6.35	
M1	0-5"	5.57	Slight	5Y6/3	.0722	2.26	.70	1.56	
M2	5-9"	3.32	None	5Y6/3	.0998	3.12	- .70	3.82	

TABLE 24

ACID-BASE ACCOUNT OF DA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
N1	0-4"	6.29	None	5Y6/4	.0281	.88	4.92		4.04
N2	4-8"	4.36	None	5Y6/3	.0369	1.15	1.17		.02
O1	0-4"	6.96	Moderate	5Y5/3	.2326	7.27	20.61		13.34
O2	4-11"	2.68	None	2.5Y6/4	.4326	13.63	-5.62	19.25	
O3	11-15"	3.36	None	5Y5/3	.3334	10.42	0.00	10.42	
P1	0-4"	6.92	Moderate	5Y5/3	.3649	11.40	24.66		13.26
P2	4-8"	4.36	None	5Y5/3	.1232	3.85	6.33		2.48
Q1	0-4"	4.22	None	5Y6/3	.0445	1.39	0.00	1.39	
Q2	4-8"	3.90	None	5Y6/3	.0284	.89	.94		.05
R1	0-4"	6.86	Moderate	5Y6/3	.0870	2.72	20.61		17.89
R2	4-8"	5.13	None	5Y6/3	.0904	2.83	2.11	.72	

TABLE 25

NUTRIENT STATUS REPORT - DISPOSAL AREA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
A1	0-4"	5.10	63	448	13824	437	28
A2	4-8"	2.60	10	166	5130	491	28
B1	0-3"	6.90	78	492	9288	524	22
B2	3-8"	4.37	8	154	1512	518	26
C1	0-6"	6.52	43	236	13662	513	50
C2	6-10"	2.77	28	114	1836	427	28
D1	0-5"	6.47	48	396	11178	556	44
D2	5-9"	3.85	10	232	1674	470	38
E1	0-5"	4.20	23	222	3348	319	34
E2	5-9"	3.59	8	142	1350	394	36
F1	0-4"	6.27	116	498	17658	454	56
F2	4-8"	3.30	13	144	1728	356	60
G1	0-4"	6.64	23	238	10260	351	28

TABLE 25

NUTRIENT STATUS REPORT - DISPOSAL AREA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
G2	4-8"	3.07	8	134	1404	259	16
H1	0-4"	3.59	21	54	4428	297	18
H2	4-8"	2.57	8	90	1566	556	22
I1	0-4"	7.05	100	254	22032	389	42
I2	4-8"	3.95	24	168	2916	394	44
J1	0-4"	6.86	60	264	14958	297	24
J2	4-8"	3.23	10	118	1134	173	18
K1	0-4"	5.46	40	234	8640	238	26
K2	4-8"	3.09	6	136	1350	178	16
L1	0-4"	4.91	52	208	6642	275	26
L2	4-8"	2.93	10	68	2268	432	22
M1	0-5"	4.83	19	232	5832	302	20
M2	5-9"	3.15	27	186	3294	378	24

TABLE 25

NUTRIENT STATUS REPORT - DISPOSAL AREA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
M1	0-4"	4.63	126	208	4320	351	20
M2	4-8"	3.52	22	176	2430	221	20
O1	0-4"	6.12	27	370	13824	459	40
O2	4-11"	2.52	10	76	4806	745	24
O3	11-15"	3.41	12	282	3726	518	42
P1	0-4"	6.62	106	396	15282	335	32
P2	4-8"	3.37	85	488	5508	367	34
Q1	0-4"	3.07	22	126	1944	216	20
Q2	4-8"	3.01	12	116	1350	113	16
R1	0-4"	6.37	56	374	15012	389	32
R2	4-8"	2.88	22	258	3348	265	26

Plant available calcium is high reflecting the increased liming rates in the surface layer and ranges from medium to high in the deeper sampling points.

Table 26 reveals aluminum concentrations decrease with increasing pH with values higher below pH 4.0. Extremely high concentrations of aluminum will inhibit root penetration into acid-toxic soils. At lower pH values the micronutrients are more mobile and will reach toxic levels for most plants. Much of the lime has not yet reacted to immobilize concentrations of micronutrients in the surface layers.

The inherently high potassium and magnesium values in most of the disposal areas constructed from typical Eutaw beds originate in the glauconite sand or green sand. Glauconite is a mineral with the formula K_{15} (Fe, Mg, Al)$_4$ - (Si, Al)$_8$ - O_{20} (OH)$_4$ that occurs abundantly in green sand. As glauconite begins to weather in the disposal areas, magnesium and potassium become available for plant use.

Phosphorus values are high to very high on acid or extremely acid soils (1503 and 1504) and is tied to the properties of the overburden (typical Eutaw beds). With the oxidation of pyrite and subsequent formation of sulfuric acid, a natural phosphate producing system is set in motion. Sulfuric acid reacts with primary phosphate minerals forming phosphoric acid which is exactly how phosphorus fertilizers are manufactured. The "Auto-fertilizing" by weathering processes elevate the fertility level of many of the disposal areas. Adequate neutralizers to slow this process will establish sustaining plant growth if surface erosion is controlled with sufficient mulch.

A subsequent examination of selected samples from overburden cores by x-ray diffraction reveals the presence of illite and scorzalite.

TABLE 26

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	PPM Cu	PPM Zn	PPM Fe
A1	0-4"	5.1	< .20	78	.9	4.1	296
A2	4-8"	2.6	4.43	107	.9	4.3	377
B1	0-3"	6.9	< .20	35	.6	6.0	157
B2	3-8"	4.4	.85	12	.4	.8	11
C1	0-6"	6.5	< .20	59	.7	7.9	155
C2	6-10"	2.8	3.07	90	.5	2.9	293
D1	0-5"	6.5	< .20	53	.5	2.8	161
D2	5-9"	3.9	.56	47	.6	1.4	70
E1	0-5"	4.2	.56	39	.4	2.3	141
E2	5-9"	4.0	2.05	48	.4	1.7	128
F1	0-4"	6.3	< .20	75	.6	4.7	88
F2	0-4"	6.6	< .20	58	.5	4.4	315

TABLE 26

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	PPM Cu	PPM Zn	PPM Fe
G2	4-8"	3.1	2.18	42	.4	2.0	136
H1	0-4"	4.0	2.58	32	.4	3.1	199
H2	4-8"	2.6	4.83	71	.5	3.7	354
I1	0-4"	7.1	< .20	61	.7	5.9	41
I2	4-8"	4.0	1.18	88	.6	1.7	113
J1	0-4"	6.9	< .20	53	.5	6.0	140
J2	4-8"	3.2	2.51	28	.3	4.6	113
K1	0-4"	5.7	< .20	42	.5	3.7	146
K2	4-8"	3.1	2.89	43	.2	1.7	173
L1	0-4"	4.9	< .20	58	.5	2.6	179
L2	4-8"	2.9	3.65	174	.2	1.8	280
M1	0-5"	4.8	< .20	51	.4	1.6	157
M2	5-9"	3.2	2.36	71	.4	1.7	188

TABLE 26

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 1203

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
N1	0–4"	4.6	< .20	53	.3	3.1	109
N2	4–8"	3.5	1.58	41	.3	1.2	173
O1	0–4"	6.1	< .20	63	.5	2.0	495
O2	4–11"	2.5	7.58	126	.7	4.7	672
O3	11–15"	3.4	1.93	89	.5	1.7	494
P1	0–4"	6.6	< .20	60	.8	4.4	177
P2	4–8"	3.4	1.82	79	.6	2.4	221
Q1	0–4"	3.1	3.36	31	.5	3.3	204
Q2	4–8"	3.0	2.78	13	.3	2.0	152
R1	0–4"	6.4	< .20	80	.7	4.5	245
R2	4–8"	2.9	2.80	67	.6	2.3	267

illite, a clay mineral having essentially the same structure as muscovite contains appreciable quantities of potassium. When subjected to accelerated weathering conditions, such as those encountered during pyrite oxidation, potassium ions are released into soil solution. Scorzalite, a rare mineral consisting of basic phosphate of iron and aluminum, has tentatively been identified as the primary phosphate mineral responsible for high levels of plant available phosphorus in material originating in the typical Eutaw beds.

The illite x-ray diffraction peaks are similar to those expected from glauconite making exact identification difficult between these two minerals, but both are responsible for release of potassium when subjected to intense weathering.

Additional examination of the lower Eutaw beds is needed to establish the exact identify of these primary and secondary minerals but sufficient evidence is present to establish the source of plant available potassium and phosphorus. Disposal area 1203 has acceptable vegetation and spot treatment of acid-toxic areas should sustain vegetation and control erosion.

Disposal Area 501

Disposal area 501 is located on the northern end of the Divide Section and is one of the first disposal areas completed. Vegetation is vigorous over most of this area.

The soil in this disposal area originates primarily from the Gordo and Mississippian geologic formations. The landform is slightly undulating to nearly level and the disposal area is contained within a "dike-like" configuration.

Figure 14 depicts the sample locations on DA 501. Table 27 shows lower total sulfur values on this disposal area reflecting the character of the overburden. Except for samples J1, J2, K2, L1, L2, N1 and N2 which show potential to produce acidity, most samples reported in Table 27 have low potential for producing acidity. Adequate neutralizers are present in the surface layers to offset the acidity produced. With the designated use as a sport hunting field, attention to liming needs have been recognized.

Some 4-8 layers are potentially toxic (samples K2, J2, L2 and N2). Sample J1 has the highest level of lime found on 501. We sampled from 0-1 inch and from 1-5 inches to determine if the neutralizers were present just on the surface. The 1-5 inch layer is acid-toxic and it will be interesting to observe this area and monitor the vegetation. The percent sulfur on sampling point J is one of the highest found on this disposal area.

High sulfur values (>.4%) and the presence of conglomerate rock from the Gordo formation at sampling point J indicates the presence of pyrite in the Gordo portion of the overburden.

The overall fertility was somewhat lower in the original soil used in construction of this disposal area. Table 28 substantiates this with higher levels of plant nutrients in the soil surface than in the underlying sampling depth due to surface applications of fertilizer.

Table 29 shows similar trends for micronutrients reported for the previous disposal areas. Manganese concentrations are high in samples C1, C2 and J1. These higher manganese values are probably from the weathering of the conglomerate originating in the Gordo formation releasing manganese present as the cementing agent in these rocks.

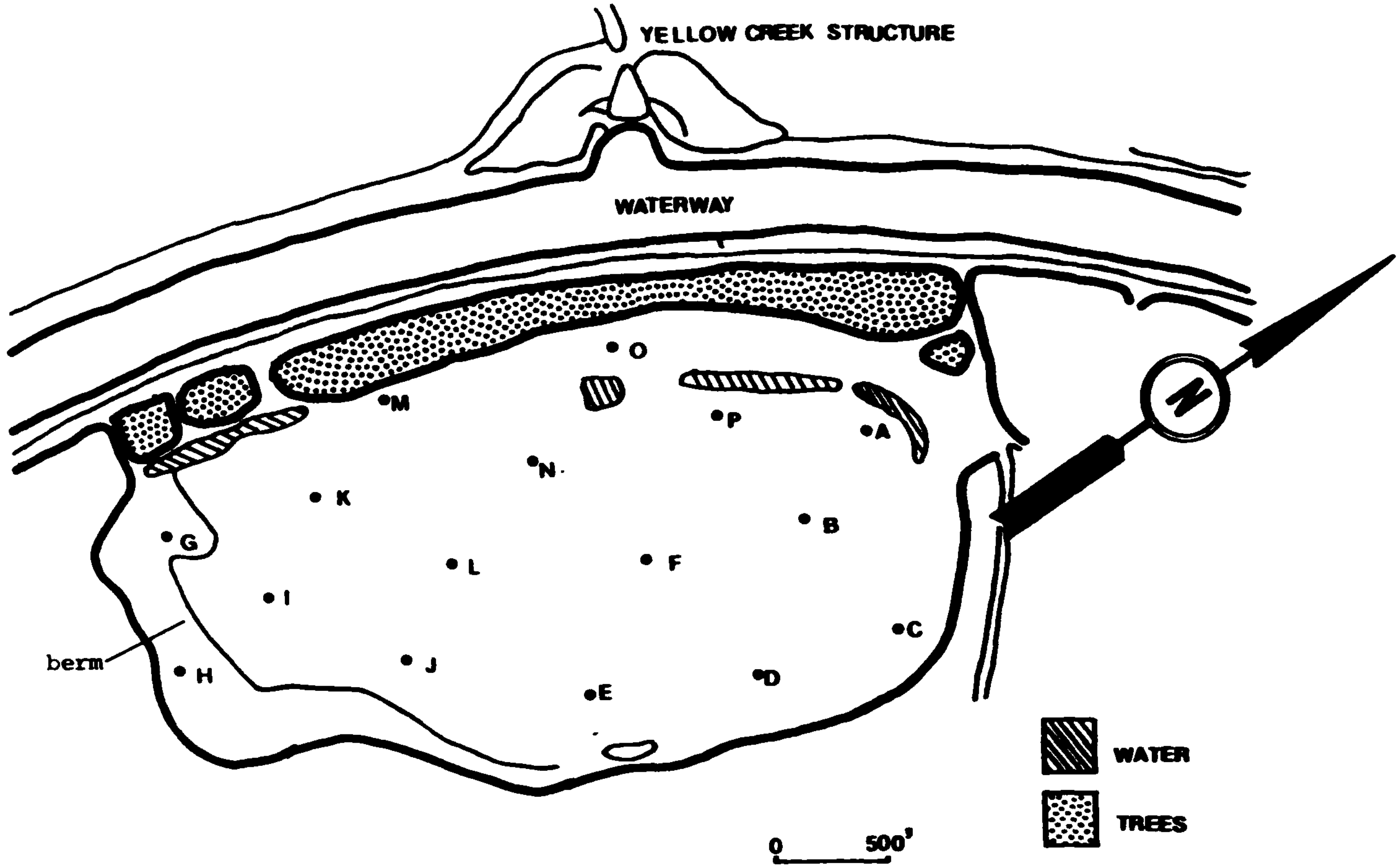

Figure 14. Sample locations on disposal area 501

TABLE 27

ACID-BASE ACCOUNT OF DA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
A1	0–4"	4.7	None	10YR6/4	.0244	.76	.94		.18
A2	4–8"	4.2	None	10YR7/4	.0167	.52	.23	.29	
B1	0–6"	5.9	None	10YR7/3	.0274	.86	3.75		2.89
B2	6–10"	5.0	None	10YR7/4	.0456	1.43	.70	.73	
C1	0–4"	4.5	None	10YR6/4	.0411	1.28	- .47	1.75	
C2	4–8"	4.5	None	10YR6/4	.0473	1.48	- .23	1.71	
D1	0–6"	6.6	None	10YR6/1	.0240	.75	3.98		3.23
D2	6–11"	4.2	None	10YR6/4	.0224	.70	- .71	1.41	
E1	0–4"	6.7	Slight	10YR6/4	.0373	1.17	10.54		9.37
E2	4–9"	4.6	None	10YR6/3	.0350	1.09	.23	.86	
E3	9–13"	4.3	None	10YR6/3	.0337	1.05	.70	.35	
F1	0–4"	4.3	None	10RY6/6	.0195	.61	-1.64	2.25	
F2	4–8"	4.3	None	10YR7/4	.0301	.94	-2.30	3.24	
G1	0–1"	6.3	Moderate	10YR6/4	.0391	1.22	25.44		24.22

TABLE 27

ACID-BASE ACCOUNT OF DA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
G2	1-6"	4.4	None	10YR6/4	.0370	1.16	-2.62	3.78	
H1	0-4"	7.3	Slight	10YR6/3	.0192	.60	11.65		11.05
H2	4-8"	5.5	None	10YR6/4	.0201	.63	-1.43	2.06	
I1	0-4"	6.9	Slight	10YR6/4	.0241	.75	10.94		10.19
I2	4-8"	4.9	None	10YR7/4	.0351	1.10	-1.90	3.00	
J1	0-1"	7.0	Strong	10YR6/3	.4153	12.98	216.90		203.92
J2	1-5"	5.8	Slight	10YR6/4	.4589	14.34	0.00	14.34	
K1	0-4"	6.3	Moderate	10YR5/4	.0527	1.65	14.50		12.85
K2	4-8"	4.3	None	10YR6/3	.1144	3.58	-2.38	5.96	
L1	0-4"	6.2	Slight	10YR7/4	.2042	6.38	5.23	1.15	
L2	4-8"	4.1	None	10YR7/4	.2071	6.47	.24	6.23	
M1	0-4"	7.1	Slight	10YR6/3	.0258	.81	19.14		18.33
M2	4-8"	4.5	None	10YR7/3	.0396	1.24	-1.63	2.87	
N1	0-4"	6.1	Moderate	20YR5/3	.5772	18.04	38.51		20.47

TABLE 27

ACID-BASE ACCOUNT OF DA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
N2	4-8"	4.8	None	10YR6/4	.2755	8.61	-1.40	10.01	
O1	0-3"	6.8	Slight	10YR7/2	.0348	1.09	7.47		6.38
O2	3-8"	5.8	None	10YR6/3	.0238	.74	.47	.27	
P1	0-3"	5.6	None	10YR6/4	.0128	.40	.70		.30
P2	3-8"	5.7	None	10YR7/4	.0120	.38	1.41	1.03	

TABLE 28

NUTRIENT STATUS REPORT - DISPOSAL AREA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
A1	0-4"	4.1	68	200	756	86	22
A2	4-8"	3.6	23	74	216	32	18
B1	0-6"	5.5	55	206	2808	113	20
B2	6-10"	3.9	14	94	702	103	24
C1	0-4"	4.0	60	188	702	205	22
C2	4-8"	3.9	12	70	756	238	28
D1	0-6"	5.7	39	134	3294	119	18
D2	6-11"	3.7	10	48	432	86	20
E1	0-4"	6.1	38	136	7992	157	22
E2	4-9"	3.5	14	50	756	81	14
F1	0-4"	3.7	21	134	540	216	20
F2	4-8"	3.7	8	108	486	275	46
G1	0-1"	5.6	15	96	15444	194	28

TABLE 28

NUTRIENT STATUS REPORT - DISPOSAL AREA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
G2	1-6"	4.0	7	72	756	124	26
H1	0-4"	6.3	55	196	10044	243	28
H2	4-8"	3.9	18	24	270	38	14
I1	0-4"	6.0	51	184	8046	416	28
I2	4-8"	4.4	12	106	1296	302	28
J1	0-1"	6.4	61	48	27108	972	52
J2	1-5"	3.6	61	46	6966	691	24
K1	0-4"	5.7	53	105	12420	297	28
K2	4-8"	3.5	21	84	1188	243	22
L1	0-4"	4.0	26	20	5346	265	20
L2	4-8"	2.9	26	14	2106	248	16
M1	0-4"	6.0	54	214	11502	529	60
M2	4-8"	3.9	3	138	1188	508	66
N1	0-4"	6.0	45	48	23544	1253	30

TABLE 28

NUTRIENT STATUS REPORT - DISPOSAL AREA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
N2	4-8"	3.9	45	36	3240	551	16
O1	0-3"	5.6	55	208	5130	265	34
O2	3-8"	3.9	30	46	486	81	26
P1	0-3"	4.6	28	156	1242	405	24
P2	3-8"	4.5	8	102	1134	508	38

TABLE 29

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	PPM Cu	PPM Zn	PPM Fe
A1	0–4"	4.1	.64	46	0.6	4.6	437
A2	4–8"	3.6	1.02	31	0.5	1.5	287
B1	0–6"	5.5	< .20	81	1.2	8.5	321
B2	6–10"	3.9	.76	75	1.7	6.7	249
C1	0–4"	4.0	1.78	220	1.0	6.2	368
C2	4–8"	3.9	1.45	301	0.9	5.9	242
D1	0–6"	5.7	< .20	75	0.7	2.9	260
D2	6–11"	3.7	2.54	93	0.7	7.8	178
E1	0–4"	6.1	< .20	96	0.8	5.0	289
E2	4–9"	3.5	1.29	54	0.4	2.1	114
E3	9–13"	3.4	1.25	59	0.5	2.4	246
F1	0–4"	3.7	5.45	113	0.7	2.9	200
F2	4–8"	3.7	5.34	160	1.1	8.2	127

TABLE 29

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	PPM Cu	PPM Zn	PPM Fe
G1	0-1"	5.6	< .20	108	0.8	1.9	112
G2	1-6"	4.9	5.31	197	0.8	17.8	150
H1	0-4"	6.3	< .20	70	0.9	1.6	147
H2	4-8"	3.9	.82	28	0.3	0.7	81
I1	0-4"	6.0	< .20	98	1.5	6.5	693
I2	4-8"	4.4	1.22	135	1.2	5.5	409
J1	0-1"	6.4	< .20	107	0.5	15.0	2
J2	1-5"	3.6	1.20	80	1.0	6.9	992
K1	0-4"	5.7	< .20	112	0.7	3.4	237
K2	4-8"	3.5	2.00	176	0.8	2.7	361
L1	0-4"	4.0	.62	256	0.9	3.3	215
L2	4-8"	2.9	2.36	267	0.9	5.2	496
M1	0-4"	6.0	< .20	85	1.2	6.0	207
M2	4-8"	3.9	5.49	173	1.2	3.9	235

TABLE 29

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA 501

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
N1	0–4"	6.9	< .20	541	0.8	8.5	660
N2	4–8"	3.9	.56	566	0.4	5.1	1320
O1	0–3"	5.6	< .20	173	0.7	9.6	265
O2	3–8"	3.9	1.36	60	0.4	7.1	220
P1	0–3"	4.6	2.51	90	0.4	0.9	85
P2	3–8"	4.5	3.96	98	0.6	1.0	76

KCl extractable aluminum increases in concentration with decreasing pH, which is the same trend found in the other disposal areas.

The disposal area has sustaining vegetation except for scattered acid spots at the surface. These acid spots exist in varying degrees on disposal areas on the northern end of the divide section with most needing spot treatments only.

RESULTS AND DISCUSSION

DISPOSAL AREAS

PHYSICAL CHARACTERIZATION

RESULTS AND DISCUSSION
DISPOSAL AREAS PHYSICAL CHARACTERIZATION

Physical characteriza 'on of the disposal areas was accomplished by selecting samples from one quarter inch disposal area subsamples for texture determinations and moisture retention determinations. Bulk density samples were removed as undisturbed clods from the field and transported to Tennessee Tech in air tight bags. Sample selection represented a cross section of the physical properties on disposal areas. Texture values by the bouyoucos hydrometer method do not show fractionated sands but field textures established many of the sandy loam textures as fine sandy loams. Sand sizes range from very fine to medium (.05 mm to .5 mm in diameter) with lower percentages of coarse sands (.5 mm to 2 mm in diameter). Tied to the laboratory physical measurements were extensive sample morphology reported in Appendix D. Various aspects of root growth and field observations with field pH, texture, and color were also completed and reported in Appendix D.

The field and laboratory textures were comparable and a valid estimation of all textures is reported in Appendix D (sampling logs). Table 30 shows a cross section of laboratory textures from the disposal areas. Table 30 reveals a low percentage of silt, high percentage of sand and variable amounts of clay with no clay percentage exceeding 35 percent. Field textures, however, (Appendix D) point to higher clay content in some samples. With textures low in silt and high in sand, low available water to the plants is assumed a problem. The soil textures are variable in a soil profile on these disposal areas. Contrasting discontinuous layers representing all textural classes (Appendix D) occur in the rootzone (0-40 inches).

TABLE 30

SOIL TEXTURE (HYDROMETER) ON SELECTED DISPOSAL AREA SAMPLES - DIVIDE SECTION - TENNESSEE - TOMBIGBEE WATERWAY

Sample Number	Depth (in)	% Clay	% Silt	% Sand	Texture Class
1203-B1	0-3	18.0	4.8	77.2	SL
1203-C1	0-6	17.0	1.8	81.2	SL
1023-C2	6-10	16.0	2.8	81.2	SL
1203-D1	0-5	19.6	4.0	76.4	SL
1203-D2	5-9	17.2	6.4	76.4	SL
1203-E1	0-5	17.6	9.2	73.2	SL
1203-E2	5-9	21.6	10.8	67.6	SCL
1203-F1	0-4	14.2	7.0	78.8	SL
1203-F2	4-8	12.8	8.4	78.8	SL
1203-G1	0-4	2.8	2.4	94.8	S
1203-G3	4-8	7.0	1.0	92.0	S
1203-H1	0-4	11.2	4.0	84.8	LS
1203-I1	0-4	12.0	8.0	80.0	LS
1203-I2	4-8	15.0	8.0	77.0	SL
1203-J1	0-4	13.0	0.0	87.0	LS
1203-J2	4-8	15.4	4.0	80.6	SL
1203-K1	0-4	19.0	2.0	79.0	SL
1203-K2	4-8	9.8	0.0	90.2	LS
1203-L1	0-4	19.8	4.0	76.2	SL
1203-L2	4-8	11.4	6.8	81.8	LS
1203-M1	0-5	17.8	1.0	81.2	SL

TABLE 30 (continued)

Sample Number	Depth (in)	% Clay	% Silt	% Sand	Texture Class
1203-M1	5-9	19.4	.8	79.8	SL
1203-O1	0-4	17.8	1.0	81.2	SL
1203-O2	4-11	21.0	14.8	64.2	SCL
1203-O3	11-15	19.0	8.8	72.2	SL
1203-P1	0-4	27.2	1.4	71.4	SCL
1203-P2	4-8	21.4	3.2	75.4	SCL
1203-Q1	0-4	23.8	4.8	71.4	SCL
1203-Q2	4-8	12.0	17.6	70.4	SL
1203-R1	0-4	22.8	2.8	74.4	SCL
1203-R2	4-8	24.0	4.4	71.6	SCL
1204-A1	0-4	19.8	2.8	77.4	SL
1204-A2	4-8	12.0	1.0	87.0	LS
1204-B2	4-8	13.8	2.8	83.4	LS
1204-C1	0-5	7.0	2.0	91.0	S
1204-D1	0-5	2.8	1.0	96.2	S
1204-D2	5-10	11.8	6.4	81.8	SL
1204-E1	0-8	9.2	2.8	88.0	LS
1204-E2	8-14	18.0	4.8	77.2	SL
1204-G1	0-6	17.0	4.8	78.2	SL
1204-G2	6-12	16.8	10.2	73.0	SL
1204-G3	12-16	4.0	2.8	93.2	S
1204-H1	0-6	6.6	0.0	93.4	S
1204-H2	6-12	3.8	1.0	95.2	S
1204-H3	12-15	16.0	1.8	82.2	SL

TABLE 30 (continued)

Sample Number	Depth (in)	% Clay	% Silt	% Sand	Texture Class
1204-I1	0-4	11.2	5.2	83.6	LS
1204-I2	4-8	12.0	3.6	82.0	LS
1204-J1	0-4	16.8	2.0	81.2	SL
1204-J2	4-8	20.0	2.8	77.2	SL
1204-K1	0-4	9.2	1.2	89.6	S
1204-K2	4-8	9.2	0.5	90.3	S
1204-L1	0-4	10.4	1.2	88.4	LS
1204-L2	4-9	14.4	5.2	80.4	LS
1204-L3	9-11	16.6	10.2	73.2	SL
1204-M1	0-4	14.0	0.5	85.5	LS
1204-N1	0-4	9.2	1.0	89.8	S
1204-N2	0-4	7.6	0.5	91.9	S
1204-O1	0-5	16.0	2.0	82.0	SL
1204-O2	5-10	8.0	1.0	91.0	S
1204-P2	5-8	30.0	8.0	62.0	SCL
1204-Q1	0-4	23.0	17.0	60.0	SCL
1204-Q2	4-9	22.8	3.2	74.0	SCL
1204-Q3	9-13	20.4	1.6	78.0	SCL
1204-R1	0-4	5.0	3.8	91.2	S
1204-R2	4-8	12.0	0.5	87.5	LS
1704-A1	0-4	18.0	9.8	72.2	SL
1704-A2	4-8	15.2	7.6	77.2	SL
1704-B1	0-6	19.2	14.8	66.0	SL
1704-B2	6-12	34.8	28.4	36.8	CL

TABLE 30 (continued)

Sample Number	Depth (in)	% Clay	% Silt	% Sand	Texture Class
1704-C1	0-4	17.2	5.6	77.2	SL
1704-C2	4-8	17.6	9.2	73.2	SL
1704-D1	0-4	17.2	9.6	73.2	SL
1704-D2	4-8	19.2	4.8	76.0	SL
1704-E	0-4	15.2	4.8	80.0	SL
1704-E2	4-8	17.6	7.2	75.2	SL
1704-F1	0-4	20.8	1.2	78.0	SCL
1704-F2	4-8	12.4	1.0	86.6	LS
1704-G1	0-4	20.4	9.6	70.0	SCL
1704-G2	4-8	16.4	6.8	76.8	SL
1704-H1	0-4	18.4	12.8	68.8	SL
1704-H2	4-8	25.4	17.8	56.8	SCL
501-A1	0-4	14.8	22.8	63.4	SL
501-A2	4-8	12.0	17.6	70.4	SL
501-B1	0-6	15.0	7.8	77.2	SL
501-C1	0-4	18.8	12.2	69.0	LS
501-C2	4-8	22.8	23.6	53.6	SCL
501-D1	0-6	14.8	17.2	68.0	SL
501-D2	6-11	15.8	9.1	75.1	SL
501-E1	0-4	13.0	3.6	82.4	LS
501-E2	4-9	8.0	1.8	90.2	S
501-E3	9-13	11.0	8.6	80.4	LS
501-F1	0-2	21.4	14.8	63.8	SCL
1503-L1	0-5	12.0	17.6	70.4	SL

TABLE 30 (continued)

Sample Number	Depth (in)	% Clay	% Silt	% Sand	Texture Class
1503-L2	5-10	16.0	10.8	73.2	SL
1503-L3	13-17	19.0	5.8	75.2	SL
1503-M1	0-5	20.0	13.6	66.4	SL

S - sand
LS - loamy sand
SL - sandy loam
SCL - sandy clay loam
CL - clay loam

Table 31 shows bulk density, particle density, and total porosity by the Varsol method on selected sampling from the disposal areas. Bulk densities were determined on samples that "held together" during transportation to Cookeville - samples that did not hold together in the field were not transported and do not present serious density problems. The sampling is biased and represents a cross section of densities between 1.3 g/cm^3 and 1.8 g/cm^3. These bulk densities are not unusually high, considering sands and sandy loams have bulk densities up to 1.8 g/cm^3 in undisturbed conditions. Total porosity values in most instances indicate normal conditions for proper air water relationship. Calculated particle density (Table 31) represents the density of the solids. These values are close to the "ideal" value for most mineral soils - 2.65 g/cm^3 (Brady, 1974). The particle density calculation serves as a cross-check for bulk density and porosity measurements.

Particular attention to field notes in Appendix D shows field conditions related to all sampling, including bulk density. Observations of root growth are reported in abundance as few, common and many. Roots are sized as very fine (<1 mm dia.), fine (1-2 mm dia.), medium (2-5 mm dia), and coarse (5-10 mm dia.). With clay percentages rarely exceeding 25 percent, severe compaction is not evident as would be expected in these textural classes. The soils on the disposal areas are on the low end of clay percentages susceptible to compaction (see Table 30) - not compacted readily. Mudstone or "loamstone" type materials were observed in the disposal areas and appeared to inhibit some root penetration but are not present in a continuous layer as observed in native fragipan soils.

The contrasting textures and densities within a pedon allow the roots to penetrate along some plane of weakness - allowing deep rooted

TABLE 31

BULK DENSITY, CALCULATED PARTICLE DENSITY AND TOTAL POROSITY BY THE VARSOL METHOD ON SELECTED DISPOSAL AREA SAMPLES

Sample Number	Depth (in)	Bulk Density (g/cm^3)	Calculated Particle Density (g/cm^3)	Total Porosity %
1203-B1	0-3	1.55	2.78	44.11
1203-B2	3-8	1.74	2.63	33.89
1203-C2	6-10	1.74	2.76	37.03
1203-D2	5-9	1.81	2.70	33.05
1203-E1	0-5	1.75	2.72	35.59
1203-E2	5-9	1.83	2.56	28.29
1203-F1	0-4	1.68	2.76	39.40
1203-F2	4-8	1.74	2.76	37.00
1203-G2	4-8	1.50	2.68	43.73
1203-I2	4-8	1.68	2.67	33.01
1203-J1	0-4	1.49	2.74	45.44
1203-J2	4-8	1.66	2.81	41.11
1203-L1	0-4	1.48	2.65	44.22
1203-L2	4-8	1.62	2.77	41.68
1203-M2	5-9	1.63	2.78	41.49
1203-P1	0-4	1.56	2.76	43.63
1203-P2	4-8	1.58	2.68	40.89
1203-Q1	0-4	1.53	2.72	47.79
1203-R1	0-4	1.56	2.77	43.59
1204-A1	0-4	1.73	2.77	37.54

TABLE 31 (continued)

Sample Number	Depth (in)	Bulk Density (g/cm^3)	Calculated Particle Density (g/cm^3)	Total Porosity %
1204-A2	4-8	1.68	2.77	39.49
1204-B2	4-8	1.57	2.78	43.70
1204-H2	6-12	1.51	2.76	45.13
1204-H3	12-15	1.72	2.77	37.81
1204-I2	4-8	1.66	2.60	37.00
1204-K1	0-4	1.45	2.70	46.29
1204-K2	4-8	1.51	2.71	44.33
1204-L1	0-4	1.55	2.73	43.15
1204-L2	4-9	1.59	2.75	42.13
1204-L3	9-11	1.66	2.74	39.60
1204-N1	0-4	1.69	2.78	39.21
1204-O1	0-5	1.47	2.69	45.27
1204-P2	5-8	1.36	2.77	50.90
1204-Q2	4-9	1.67	2.55	34.48
1204-Q3	9-13	1.63	2.74	40.30
1204-R1	0-4	1.19	2.52	52.90
1704-A1	0-4	1.64	2.71	39.30
1704-A2	4-8	1.65	2.79	40.62
1704-B1	0-6	1.62	2.77	34.37
1704-C1	0-4	1.59	2.71	41.43
1704-C2	4-8	1.71	2.68	36.25
1704-D1	0-4	1.61	2.69	40.06
1704-D2	4-8	1.54	2.67	42.40

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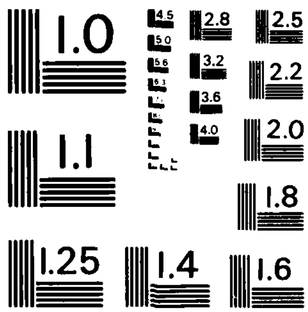

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

TABLE 31 (continued)

Sample Number	Depth (in)	Bulk Density (g/cm^3)	Calculated Particle Density (g/cm^3)	Total Porosity %
1704-E1	0-4	1.67	2.66	37.23
1704-E2	4-8	1.68	2.66	38.86
1704-F1	0-4	1.58	2.69	41.16
1704-F2	4-8	1.60	2.64	39.41
1704-G1	0-4	1.55	2.78	44.03
1704-G2	4-8	1.74	2.68	35.20
1704-H1	0-4	1.64	2.66	38.37
1704-H2	4-8	1.61	2.73	41.03
501-A1	0-4	1.78	2.70	33.94
501-C1	0-4	1.72	2.76	37.60
501-C2	4-8	1.74	2.70	35.67
501-D1	0-6	1.70	2.71	37.42
501-D2	6-11	1.77	2.72	34.93
501-E1	0-4	1.71	2.70	36.92
501-E3	9-13	1.64	2.73	39.96
501-F2	4-8	1.64	2.64	38.06
1503-L1	0-5	1.34	2.67	49.65
1503-L2	5-10	1.54	2.86	46.17
1503-L3	13-17	1.54	2.69	42.90
1503-M1	0-5	1.48	2.67	44.45
1704 Pit 1				
Layer 1	0-1			
Layer 2	1-8	1.49	2.70	44.87

TABLE 31 (continued)

Sample Number	Depth (in)	Bulk Density (g/cm^3)	Calculated Particle Density (g/cm^3)	Total Porosity %
Layer 3	8-19	1.45	2.88	49.70
Layer 4	19-31	1.75	2.62	33.00
Layer 5	31-42	1.64	2.72	39.62
Layer 6	42-48	1.65	2.59	36.14

plants to establish. Roots penetrated through most of the mudstone materials and moved along the faces of other mudstones. Sericea lespedeza formed rootmats along planes of weakness on some materials. Disposal area 501 contained rock fragments in the fill. These fragments were not common in the other five disposal areas sampled. The chert fragments provided planes of weakness at the soil-rock interface for roots to penetrate through the soil. Clay percentages are generally higher on 501 and the properties of this disposal area reflect the properties of the Mississippian formation that was excavated and deposited there. Higher numbers of rock fragments in the fill reduce the effects of severe compaction.

Data reported in Table 32 are one method in the laboratory used to estimate available water holding capacity for plant growth. The difference between 1/3 and 15 bar suction has been used as an approximation of plant available water, reported as a percentage (calculated as oven dry weight). These values generated in the laboratory are difficult to apply to the moisture regime in field situations - any laboratory method employed will not reflect true soil moisture regimes in the field but serves as an indication of soil-water relationships.

A better overview of the soil moisture regimes in the laboratory is presented in Table 33. Moisture retentions at 0.1 bar, 0.33 bar, 2 bar and 15 bar suctions were completed on textures ranging from sand to clay loam. Figures 15 through 19 are a graphic representation of five samples from Table 33. Figure 15 represents a fine sand showing little difference between 2 bar and 15 bar measurement, illustrating that most plant available water is between .1 bar and 2 bar suctions. Available water holding capacity on these sand dominated samples are the difference between .1 bar and 2 bar suction. The .1 bar to the 2 bar range

TABLE 32

MOISTURE RETENSION IN THE LABORATORY
AT 1/3 AND 15 BAR SUCTION

Sample Number	Depth (in)	1/3 bar	15 bar	Moisture retained* between 1/3 and 15 bar suction	Texture
1203-A1	0-4	28.02%	20.46%	7.56%	SCL
1203-A2	4-8	22.91%	7.48%	15.43%	SCL
1203-B1	0-3	16.51%	7.55%	8.96%	SL
1203-C1	0-6	13.30%	7.25%	5.85%	SL
1203-C2	6-10	11.74%	6.68%	5.06%	SL
1203-D1	0-5	16.30%	7.92%	8.38%	SL
1203-D2	5-9	12.01%	5.93%	6.08%	SL
1203-F1	0-4	17.03%	6.87%	10.16%	SL
1203-F2	4-8	16.47%	7.45%	9.02%	SL
1203-I2	4-8	16.19%	6.02%	10.17%	SL
1203-J1	0-4	13.65%	6.20%	7.45%	LS
1203-J2	4-8	14.80%	7.23%	7.57%	SL
1203-K1	0-4	14.19%	7.42%	6.77%	SL
1203-L1	0-4	14.97%	9.80%	5.07%	SL
1203-L2	4-8	12.51%	7.76%	4.75%	LS
1203-M1	0-5	16.31%	9.58%	6.73%	SL
1203-O1	0-4	20.57%	12.85%	7.72%	SL
1203-O2	4-11	21.44%	9.90%	11.54%	SCL
1203-P1	0-4	20.08%	10.67%	9.41%	SCL
1203-R1	0-4	24.63%	13.08%	11.55%	SCL

TABLE 32 (continued)

Sample Number	Depth (in)	1/3 bar	15 bar	Moisture retained* between 1/3 and 15 bar suction	Texture
1204-A1	0-4	17.31%	9.37%	7.94%	SL
1204-B2	4-8	13.38%	8.01%	5.37%	LS
1704-A1	0-4	18.75%	9.70%	9.05%	SL
1704-A2	4-8	17.38%	9.16%	8.22%	SL
1503-L1	0-5	17.57%	7.02%	11.55%	SL
1503-L2	5-10	16.01%	11.86%	4.15%	SL
1503-L3	13.17	13.64%	6.64%	7.00%	SL

* Used as an estimate of available water holding capacity.

S - sand
LS - loamy sand
SL - sandy loam
SCL - sand clay loam

TABLE 33

MOISTURE RETENTION IN THE LABORATORY AT 0.1, 0.33, 2 AND 15 BARS SUCTION DETERMINED ON A RANGE OF TEXTURES SELECTED FROM DISPOSAL AREA SAMPLES

Sample Number	Moisture Retention .1 bar	Moisture Retention .33 bar	Moisture Retention 2 bar	Moisture Retention 15 bar	Texture*
1204-D1	9.09%	4.75%	3.65%	3.50%	S
1203-G1	10.49%	6.13%	4.99%	4.58%	S
1204-K1	19.27%	10.95%	8.62%	7.07%	LS
1204-R2	9.59%	5.34%	4.16%	3.98%	LS
1204-M1	14.61%	7.56%	5.70%	5.03%	LS
1204-J1	24.84%	18.28%	13.03%	11.68%	SL
1204-L2	22.21%	15.27%	9.97%	7.93%	SL
1204-Q1	39.56%	25.81%	18.57%		SCL
1204-R1	10.23%	5.57%	4.62%	3.84%	S
1204-Q3	26.84%	18.71%	12.81%	9.69%	SCL
1204-P2	38.17%	19.86%	15.25%	13.40%	SCL
1704-B2	37.39%	28.30%	21.46%	14.99%	CL

* S - sand
LS - loamy sand
SL - sandy loam
SCL - sandy clay loam
CL - clay loam

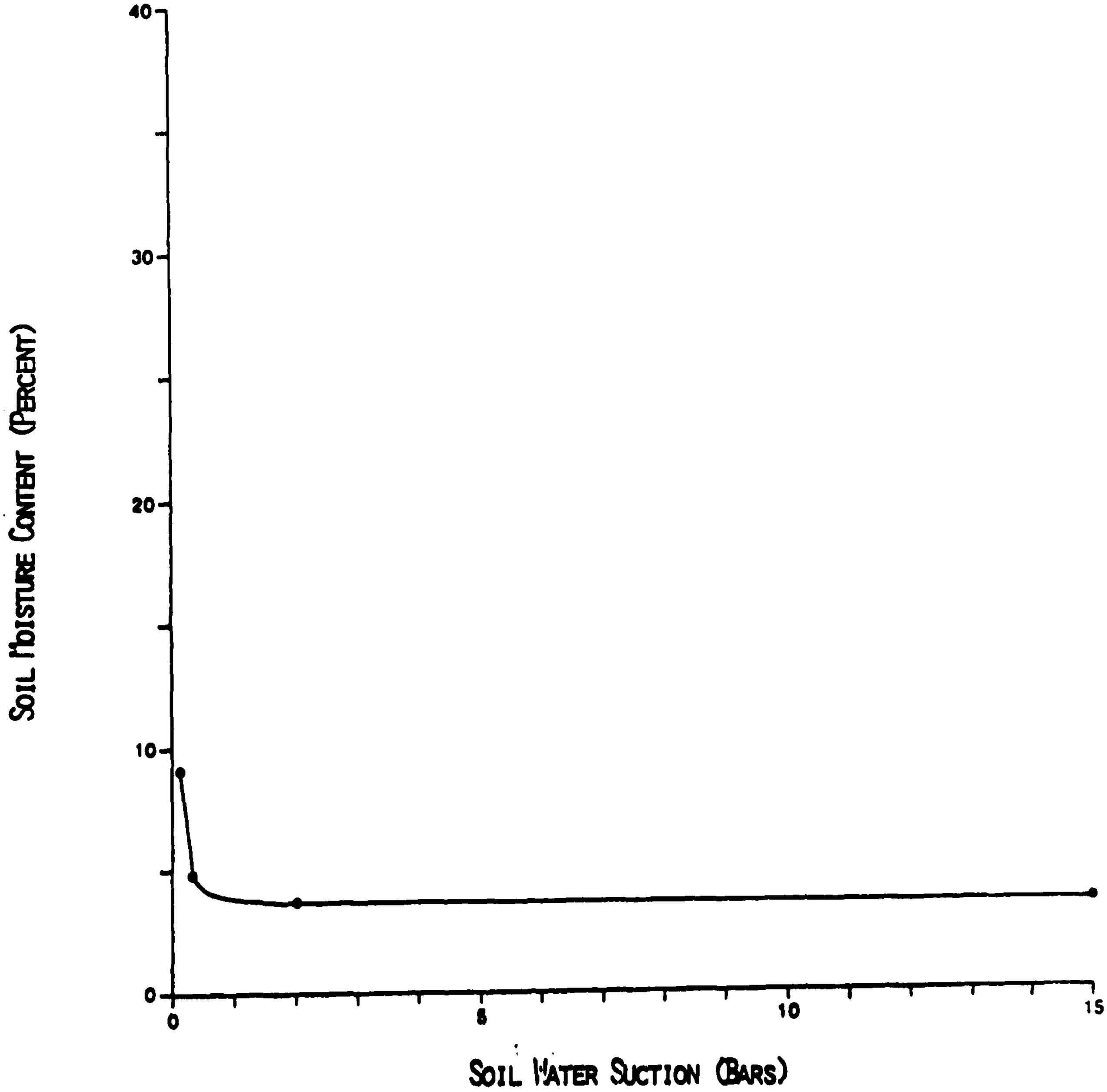

Figure 15. Relationship between soil water suction and percentage moisture retained for sand texture (1204-D1).

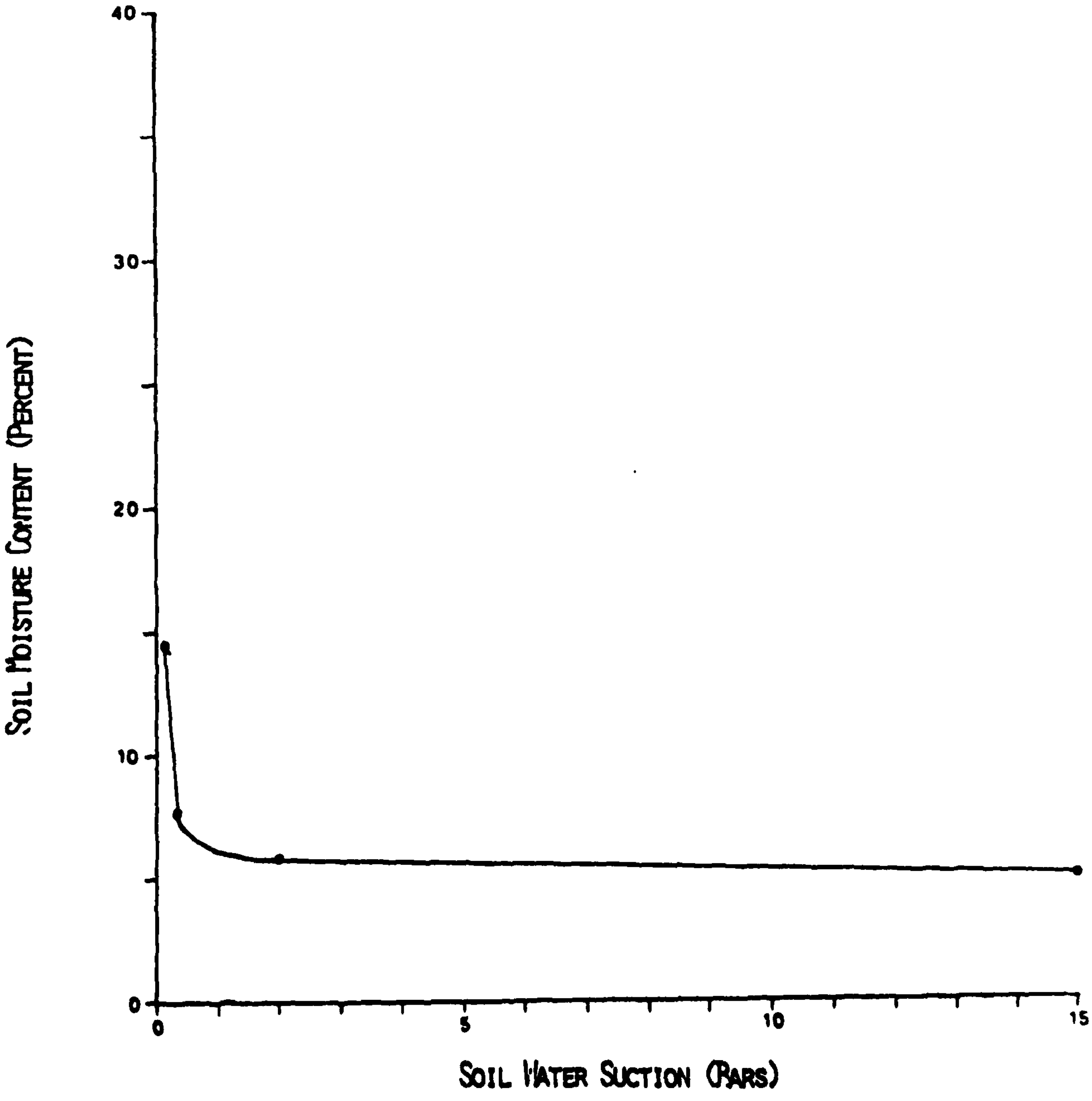

Figure 16. Relationship between soil water suction and percentage moisture retained on loamy sand texture (1204-M1).

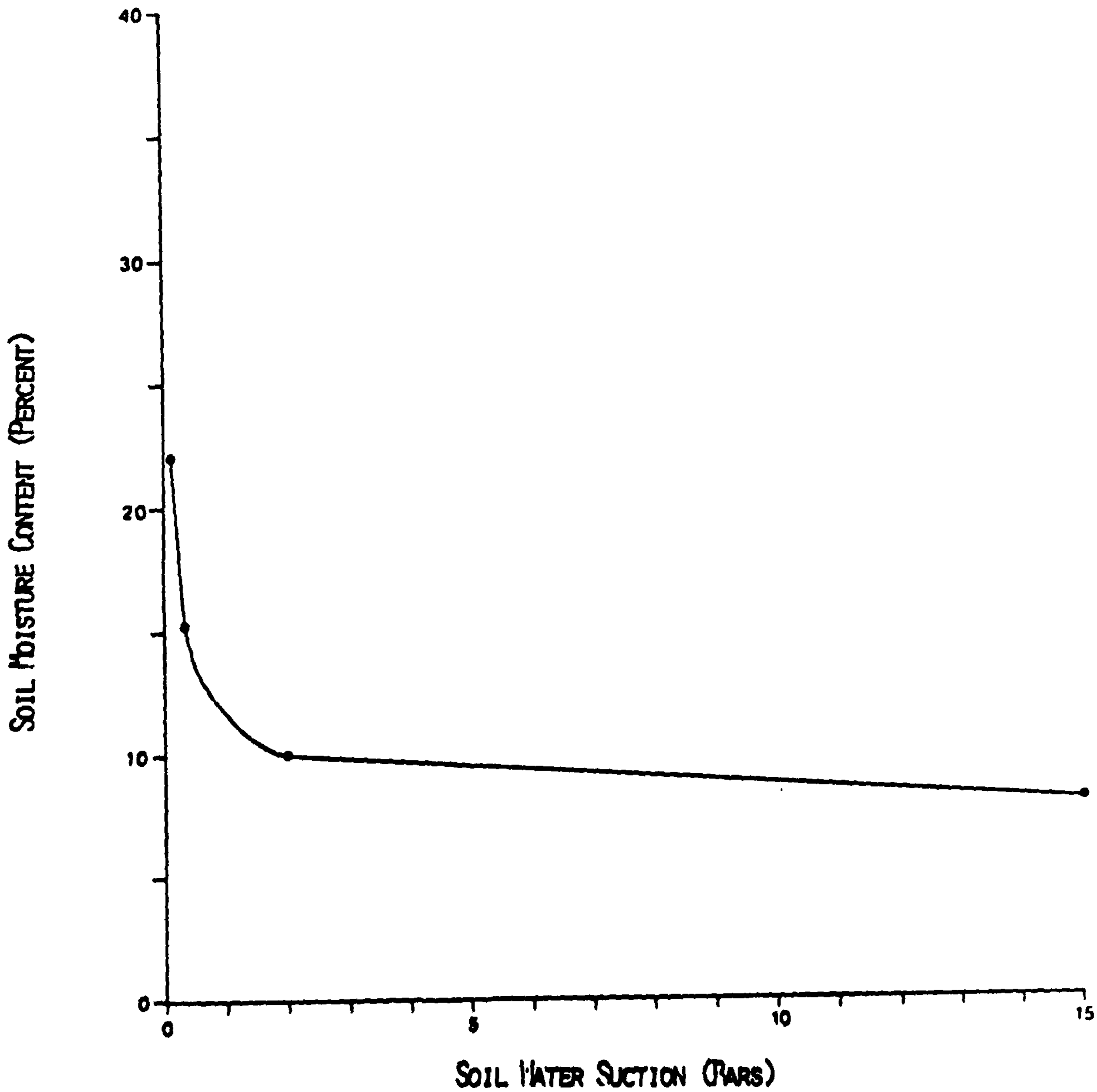

Figure 17. Relationship between soil water suction and percentage moisture retained on sandy loam texture (1204-L2).

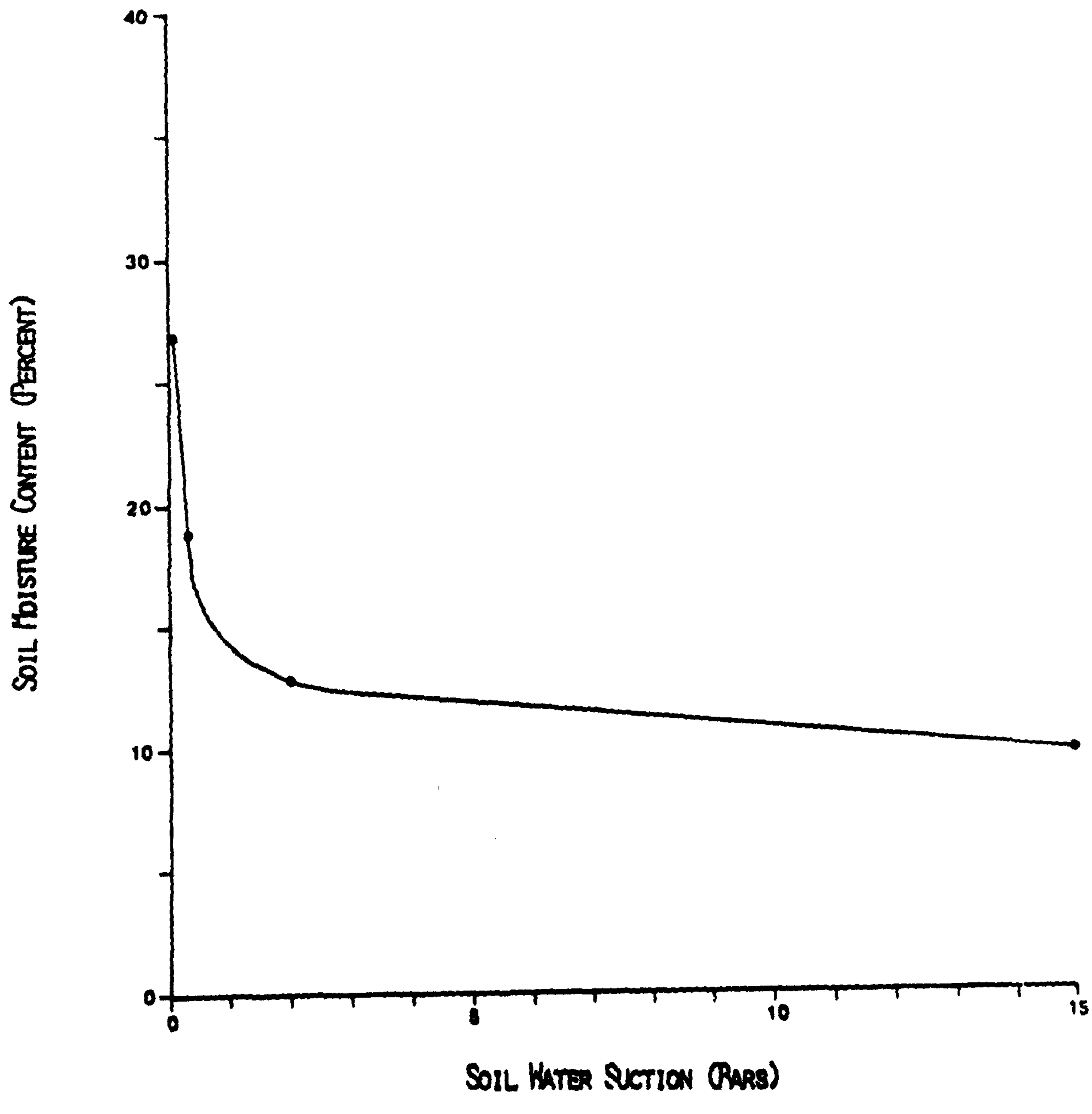

Figure 18. Relationship between soil water suction and percentage moisture retained a sandy clay loam texture (1204-Q3).

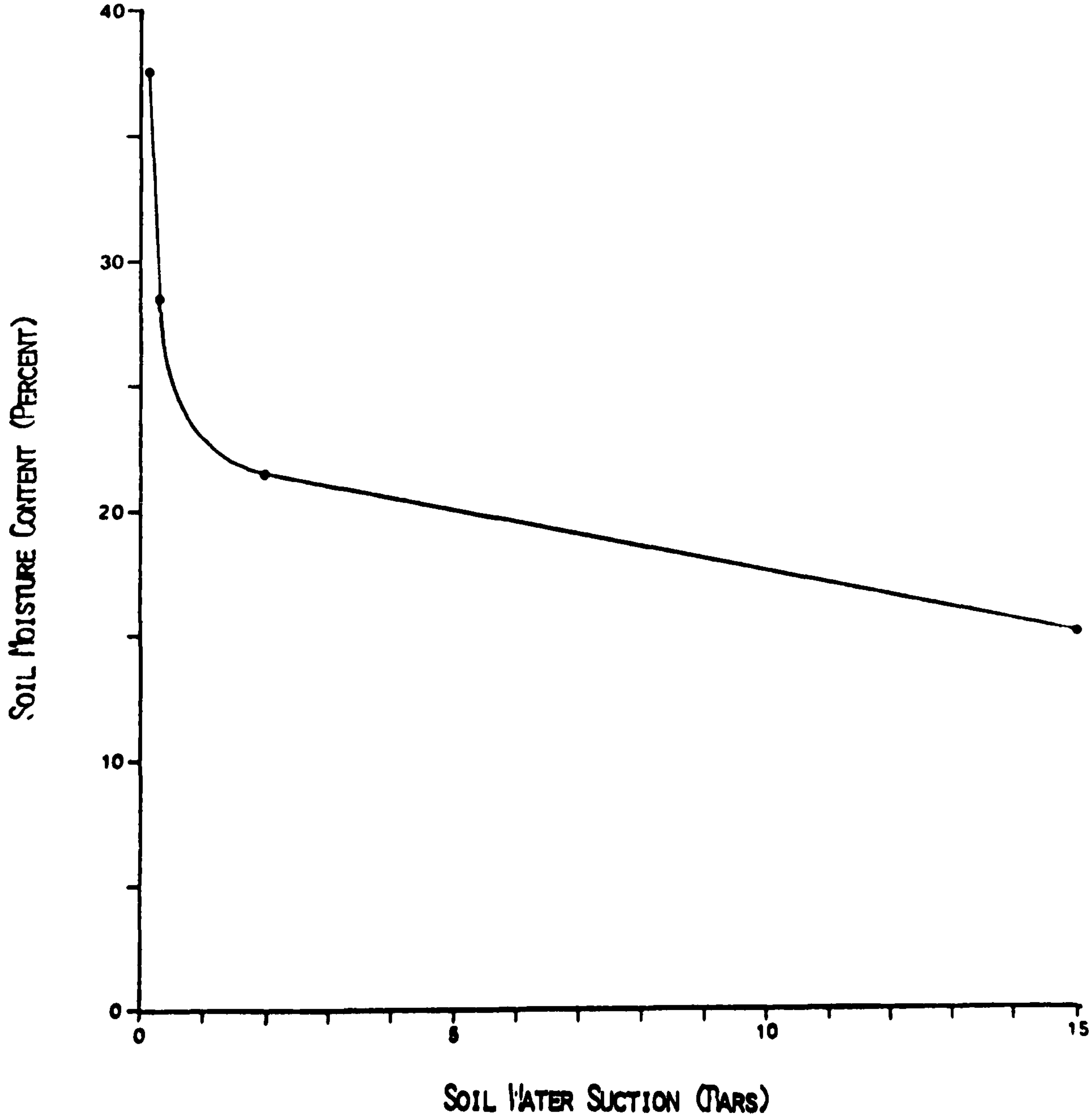

Figure 19. Relationship between soil water suction and percentage moisture retained on clay loam texture (1704-B2)

better represents the plant available water on the disposal area samples than the .33 bar to 15 bar range. Figure 16 shows a loamy sand with a slight increase in clay and silt which are reflected in the percentage moisture the sample retains. Little difference is noted between the 2 bar and 15 bar suctions, illustrating that most of the plant available water range is between .1 bar and 2 bar suctions. Figure 17, a sandy loam containing slightly more silt and clay shows a greater degree of moisture retention - 12.24 percent moisture (.162 inches water per inch of soil) in contrast to Figure 15, a sand with approximately 6 percent moisture (.07 inches water per inch of soil). Differences in the plant available moisture representing the various particle size compositions are well illustrated in Figures 15 through 19. As a soil increases in clay percentages, more water is retained at higher suctions with most plant available water retained between .1 bar and 2 bar suctions. These are estimates in the laboratory relating moisture to texture.

In disturbed soils, there are contrasting textures, bulk densities and porosities within a pedon (approximately 40 inches). All moisture retention relationships plotted in Figures 15 through 19 may be represented in a single soil profile. Visualize a series of contrasting textures of sands, clay loams, and sandy clay loam with a lens of sand 14 inches below the surface. These morphologic features prevent free drainage, thus holding low tension (.1 bar) plant available moisture in the profile. We must recognize that field soil moisture regimes can not be inferred accurately from laboratory procedures. Since we do not have many profiles consisting entirely of sand, the moisture regime in the field is adequate to sustain plant growth in most situations in the disposal areas. Severe drought stress caused by prolonged periods with

no rainfall will cause plant mortality on shallow rooted plants but sufficient rainfall in this region makes this a low probability.

Most observations made of impeded root penetration indicate that is it due primarily to acid toxic materials and associated toxic elements and not to the physical character of the disposal areas.

R E S U L T S   A N D   D I S C U S S I O N

C O M P A R I S O N   O F   R E S U L T S

O F   F O U R   L I M E   R E Q U I R E M E N T   M E T H O D S

RESULTS AND DISCUSSION
COMPARISON OF RESULTS OF FOUR LIME REQUIREMENT METHODS

Approximately 91 samples were selected from disposal area, soil profile and growth chamber pot studies to evaluate a range of soil conditions in the Divide section. Dunn's titration, five minute boiling, SMP and Woodruff's buffer lime requirement methods were used in the evaluation.

Conventional lime requirement methods either involve incubation of various levels of lime in a soil water mixture (Dunn's and five minute boiling) or use of calibrated buffers to determine reserve acidity (SMP and Woodruff's). Both methods evaluate active and reserve acidity (that H^+ and Al^{+3} in solution and that which is absorbed to clay and is exchangeable). Conventional lime requirements will not measure potential acidity or hydrogen ions produced through the oxidation of a primary acid-forming mineral such as pyrite. For this reason, conventional lime requirements do not effectively assess potential acidity present in the form of pyrite. Acid-Base Accounting is probably the best method to evaluate the potential acidity of soils containing pyrite.

Comparing the four lime requirement methods, five minute boiling and Dunn's titration lime requirement methods correlate ($r = .916$) better than any of the other relative comparisons (see Figure 20). These two methods are similar except the Dunn's is incubated for four days and the five minute boiling method involves boiling, cooling and measuring a sample in about one hour. A time saving of almost 100 hours in the laboratory is realized when using the five-minute boiling method.

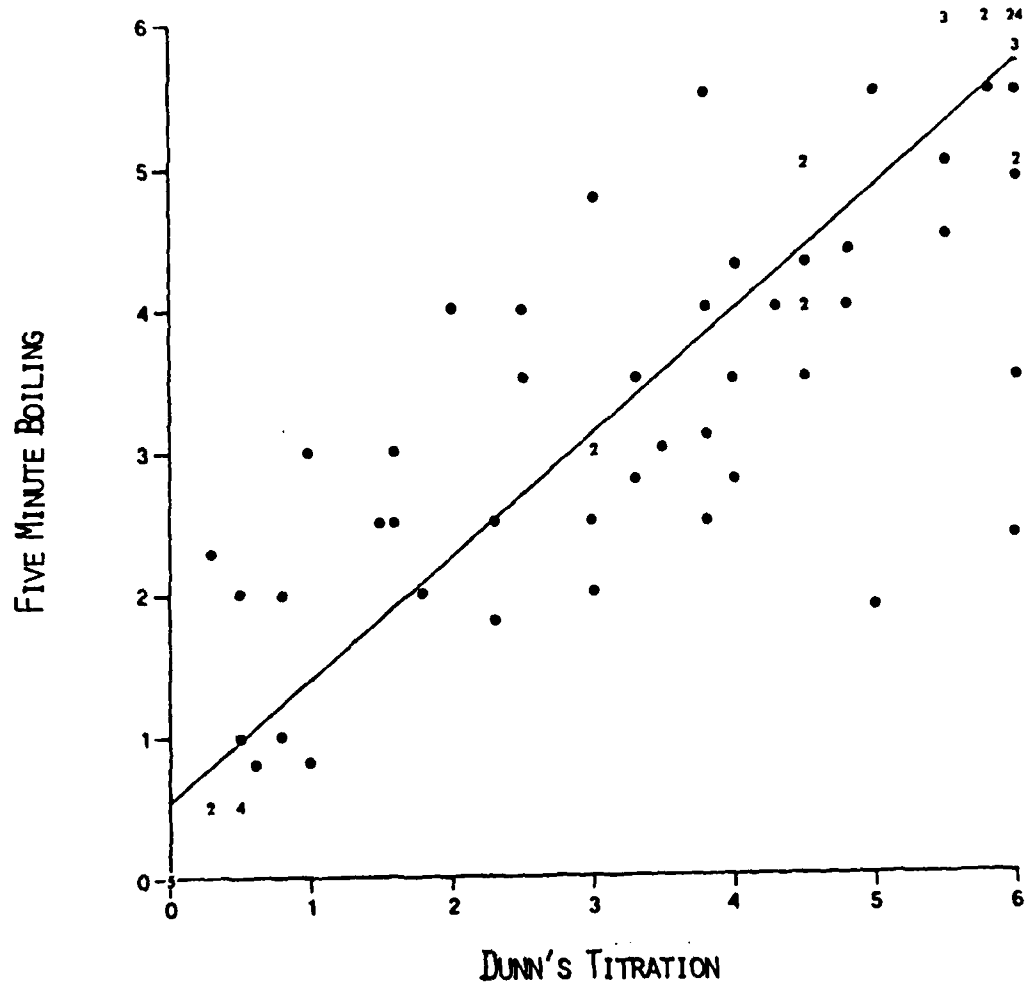

Figure 20. Relationship between Dunn's Titration and Five Minute Boiling lime requirement methods.

Dunn's titration and Woodruff's buffer lime requirement methods have an "r" value of .674 showing the relationship of a buffer method to an incubation method (Figure 21).

The SMP buffer correlated poorly with Dunn's method, Woodruff's method and five minute boiling method. Table 34 are the results of the four methods and shows the SMP is consistently higher. In most samples, a lime requirement of greater than 16 tons/1,000 tons material is reported. Table 12, Acid-Base Account of disposal area 1504 shows an excess in neutralizers in samples A through D and sustaining vegetation, but Table 34 shows the SMP lime requirement on samples A through D on DA 1504 ranging from 8.9 to greater than 16 tons/1,000 tons material $CaCO_3$ equivalent. Samples J1 and J2 in Table 12 show a deficiency 22 and 20 tons/1,000 tons material $CaCO_3$ equivalent respectively while the SMP lime requirement shows greater than 16 and 10.4 tons/1,000 tons material (tons/acre) for the same sample. Although not confirmed, certain ions are interfering with the SMP buffer. This buffer is sensitive to aluminum and was developed for acid soils, but this lime requirement method along with the others evaluated will not accurately assess the amounts of neutralizers needed to offset acidity produced by the oxidation of pyrite.

Additionally, conventional lime requirement methods will not entirely take into account the presence of lime which has been recently added. At the pH levels of the solutions used in these methods calcium carbonate is relatively insoluble, therefore only a very small amount of it will take part in the reaction. This will result in overestimation of lime requirement for areas which still contain unreacted lime.

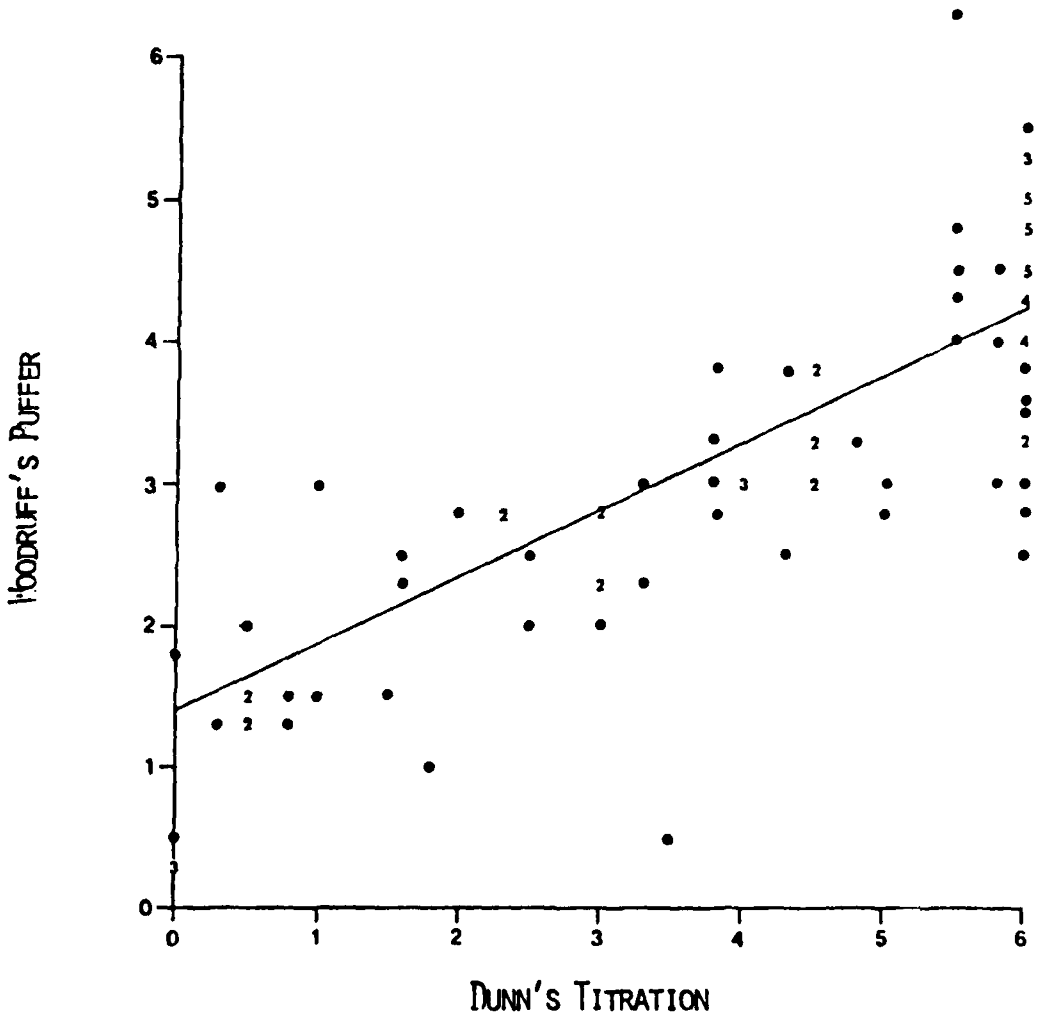

Figure 21. Relationship between Dunn's Titration and Woodruff's Buffer lime requirement methods.

TABLE 34

COMPARISON OF RESULTS OF FOUR LIME REQUIREMENT TESTS ON SELECTED DISPOSAL AREA SAMPLES (RESULTS IN TONS $CaCO_3$/1000TONS)

Sample Number	Dunn's	5 Minute	SMP Buffer	Woodruff Buffer
1504-A1	0.5	0.5	8.9	1.5
A2	0.5	1.0	>16.0	2.0
B1	0.3	0.5	8.9	1.3
B2	0.5	0.5	>16.0	1.5
C1	0.5	0.5	10.4	1.3
C2	0.5	0.5	>16.0	1.3
D1	0.6	0.8	>16.0	1.5
D2	0.3	0.5	>16.0	1.3
E1	1.6	3.0	>16.0	2.5
E2	1.6	2.5	>16.0	2.3
F1	>6.0	>6.0	>16.0	4.0
F2	>6.0	>6.0	>16.0	4.5
G1	5.8	>6.0	>16.0	4.5
G2	5.5	>6.0	>16.0	4.5
H1	4.5	5.0	>16.0	3.8
H2	3.8	4.0	>16.0	3.8
I1	1.0	3.0	>16.0	1.5
I2	3.0	3.0	10.4	2.3
J1	>6.0	>6.0	>16.0	5.0
J2	>6.0	>6.0	>16.0	5.0
K1	>6.0	>6.0	>16.0	5.5

TABLE 34 (continued)

Sample Number	Dunn's	5 Minute	SMP Buffer	Woodruff Buffer
K2	>6.0	>6.0	>16.0	5.3
L1	>6.0	5.8	>16.0	4.0
L2	>6.0	>6.0	>16.0	4.3
M1	>6.0	>6.0	>16.0	4.8
M2	>6.0	>6.0	>16.0	5.0
N1	3.0	3.0	>16.0	2.8
N2	4.5	4.0	>16.0	3.8
O1	4.0	3.5	>16.0	3.0
O2	4.3	4.0	>16.0	3.8
P1	2.3	2.5	>16.0	2.8
P2	3.3	2.8	>16.0	3.0
Q1	5.5	5.0	>16.0	4.3
Q2	>6.0	>6.0	>16.0	4.3
R1	3.3	3.5	>16.0	2.3
R2	4.0	2.8	>16.0	3.0
1503-A1	>6.0	>6.0	>16.0	4.5
A2	>6.0	5.0	>16.0	5.0
B1	2.5	3.5	>16.0	2.0
B2	5.0	5.5	>16.0	3.0
1503-C1	4.5	4.3	>16.0	3.0
C2	>6.0	>6.0	>16.0	5.3
D1	>6.0	>6.0	>16.0	5.0
D2	>6.0	>6.0	>16.0	4.8
E1	>6.0	>6.0	>16.0	4.8

TABLE 34 (continued)

Sample Number	Dunn's	5 Minute	SMP Buffer	Woodruff Buffer
E2	>6.0	>6.0	>16.0	4.3
F1	3.0	2.5	>16.0	2.3
F2	0.5	2.0	14.0	10.0
G1	0.0	0.0	>16.0	0.5
G2	4.5	4.0	>16.0	3.3
H1	5.0	>6.0	>16.0	3.0
H2	>6.0	>6.0	15.5	3.3
I1	0.0	0.0	>16.0	0.3
J1	2.3	1.8	>16.0	2.8
J2	>6.0	>6.0	>16.0	3.0
1503-Pit 1,				
Layer 1	1.5	2.5	>16.0	1.5
2	3.8	5.5	>16.0	3.0
3	3.5	3.0	>16.0	0.5
4	4.5	5.0	>16.0	3.3
5	4.0	4.3	>16.0	3.0
1503-Pit 2,				
Layer 1	4.5	3.5	>16.0	3.0
2A	5.8	5.5	>16.0	4.0
2B	>6.0	>6.0	>16.0	4.0
3	>6.0	>6.0	>16.0	4.0
4	>6.0	5.0	>16.0	4.3

TABLE 34 (continued)

Sample Number	Dunn's	5 Minute	SMP Buffer	Woodruff Buffer
1504-Pit 1,				
Layer 1	5.5	> 6.0	>16.0	4.0
2	>6.0	3.5	>16.0	5.3
3	2.5	4.0	>16.0	2.5
4	3.0	2.0	>16.0	2.0
1508-1	1.8	2.0	>16.0	1.0
2	4.8	4.0	>16.0	3.3
3	0.0	0.0	4.6	0.3
4	0.0	0.0	3.9	0.3
1302-B1	>6.0	4.9	>16.0	3.3
B2	>6.0	5.8	>16.0	4.5
B3	0.8	2.0	13.2	1.3
B4	2.0	4.0	>16.0	2.8
B5	3.8	2.5	>16.0	3.3
Treated Plots (DA 1504)				
05-08	>6.0	> 6.0	>16.0	4.5
09-12	>6.0	> 6.0	>16.0	4.8
13-16	>6.0	5.8	>16.0	2.5
17-20	3.8	3.1	>16.0	2.8
21-24	0.8	1.0	5.3	1.5
25-28	1.0	0.8	>16.0	3.0
29-32	3.0	4.8	>16.0	2.8
33-36	5.0	1.9	>16.0	2.8

TABLE 34 (continued)

Sample Number	Dunn's	5 Minute	SMP Buffer	Woodruff Buffer
37-40	5.5	4.5	11.1	4.8
41-44	>6.0	>6.0	>16.0	4.5
45-48	>6.0	>6.0	>16.0	2.8
53-56	4.3	4.4	15.5	2.5
57-60	0.3	2.3	15.5	3.0
61-64	5.5	>6.0	>16.0	6.3
65-68	>6.0	2.4	>16.0	3.6
69-72	0.0	0.0	11.1	1.8
73-76	>6.0	>6.0	>16.0	3.5
77-80	>6.0	>6.0	>16.0	3.8
Check Plot North				
	6.0	5.5	12.5	4.8

RESULTS AND DISCUSSION

SOIL PROFILE STUDIES

RESULTS AND DISCUSSION
SOIL PROFILE STUDIES

An examination of four profiles was completed on three disposal areas (1503, 1504, and 1704) to determine the morphology of these new soils. Traditional field notes on texture, color, structure, depth and other distinguishing characteristics are reported in the soil profile descriptions.

Classification of soil deposited by man is relatively new. Several approaches have been used based purely on chemical character or specific response to plant growth but have proved limited in broad adaptability for most disturbed soils. The primary purpose of a taxonomic system is for inventory and interpretative use - a system based on the properties of the soil profile.

A disturbed soil classification system was conceived at West Virginia University (Sencindiver, 1979) encompassing the philosophy of modern U.S. Soil Taxonomy. The system was developed to classify mine-soils resulting from surface mining for coal and coal waste products (refuse). Various agencies have had initial input including the National Cooperative Soil Survey. With the naming of a new suborder, a proposed amendment was made in 1975 to the National Cooperative Soil Survey.

This system is related to properties that are consistently observed in disturbed soils. These properties have an influence on overall use and plant growth. For practical application and inventory purposes, the system classifies soil in a broader group. The traditional series criteria used by the National Cooperative Soil Survey has narrow defined

limits and does not describe the variability found in disturbed soils. Most interpretative uses can be made at the family level of taxonomy and as this system is refined and geographic names assigned to each family, it can be implemented to interpret and inventory most disturbed land.

Any three of the following properties confirmed in a disturbed soil will classify the soil to the proposed suborder Spolents:

1. Coarse fragments constitute at least 10 percent of the volume of the control section, and they are disordered such that more than 50 percent will have their long axis at an angle of at least 10 percent relative to any plane in the profile. The test for disorder should exclude fragments with a maximum diameter of less than 3/4 inch or more than 10 inches and should be based on numbers of coarse fragments rather than on volume.
2. Mottles occur without regard to depth or spacing in the profile. The mottling involves color difference of at least two color chips in the standard Munsell soil color charts. This mottling occurs among fines as well as within coarse fragments or between fines and coarse fragments.
3. If coarse fragments are fissile, the edges are frayed or splintery rather than smooth.
4. Coarse fragments bridge across voids as a result of placement of materials, leaving discontinuous irregular pores larger than texture porosity. Such voids are consistently present but vary in frequency, prominence, and size.
5. The profile has a thin surface horizon or a horizon immediately below a surface pavement of coarse fragments that contains a

higher percentage of fines than any other horizon in the profile in the control section. This horizon ranges from 1 to 4 inches thick in most minesoils, but it may be thicker in minesoils that have been "topsoiled".

6. The profile has local pockets of materials, excluding single coarse fragments, that range from 3 to 40 inches in horizontal diameter. These pockets have no lateral continuity and are the results of the original placement of materials and not post-depositional processes. They may differ from surrounding material in color (two or more Munsell color chips), soil textural - or particle - size class, or dominant rock type constituting the coarse fragments.
7. Artifacts are present (paper, wire, logs, cans, glass, etc.).
8. Carbolithic coarse fragments occur in noncarbolithic spoils.
9. Oxidizable carbon is irregularly distributed with depth and not associated with stratification (laboratory determination) (Sencindiver, Ammons and Delp, 1979).

The disposal area soils in the divide section meet the criteria for this taxonomic system. Classification to the family level of taxonomy relates specifically to the plant growth zone. Once these levels of interpretation established, they can be extrapolated over larger areas for inventory purposes.

All four profiles were classified to the family level of taxonomy as Matrix Udispolents, coarse-loamy, mixed, extremely acid, thermic.

The coarse-loamy refers to the particle size class in the control section (10-40 inches). Mixed refers to mineralogy class in the control section. This brief discussion of the taxonomic system illustrates that

the different soil individuals can be identified and grouped according to properties.

A family name has tentatively been assigned as the Tombigbee Family. Utilization of an inventory system is easier by naming families rather than including the entire taxonomic name. This name is not listed as a current soil series by the National Cooperative Soil Survey avoiding conflict between family and series names.

The soil properties shown in the soil profile descriptions are found in disturbed soils resulting from surface mining for coal or other land disturbances.

The soil profile descriptions show the contrasting materials and morphologic differences separating these new soils from native soils.

Table 35 shows that potentially toxic layers are present deep in the profile. Total sulfur concentrations are high enough in these lower layers to generate acidity if exposed to an oxidizing environment at or near the soil surface. If vegetation is established with adequate neutralizers in the upper layers, sustaining vegetation can be established. Deep plowing should be avoided.

Root penetration is noted in the soil profile descriptions and with close examination of data, the roots stopped when reaching a layer of extremely acid-toxic materials.

The soil profile reveals a contrast in layers of physical and chemical character. This contrast in morphology changes physical interpretations when standard methods are employed to evaluate disturbed soils. Soil water may be more plant available throughout the disturbed profile than a native soil profile with similar texture because the continuity of pores and drainage patterns are not the same. Layers of

TABLE 35

ACID-BASE ACCOUNT OF DISPOSAL AREA PITS

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
DA 1503 Pit # 1									
Layer 1	0-3	4.8	Slight	2.5Y6/4	.0287	.90	4.15		3.25
Layer 2	3-8	3.4	None	2.5Y6/4	.0264	.83	- .46	1.29	
Layer 3	8-12	3.2	None	2.5Y6/4	.0288	.90	- .46	1.36	
Layer 4	12-35	3.1	None	2.5Y5/4	.2218	6.93	-1.38	8.31	
Layer 5	35-45	3.5	None	2.5Y6/2	.3786	11.83	-1.38	13.21	
DA 1503 Pit # 2									
Layer 1	0-4	3.7	None	2.5Y6/4	.3436	10.74	2.31	8.43	
Layer 2	4-9	2.9	None	2.5Y6/4	.1653	5.17	-2.77	7.94	
Layer 2B	4-9	2.8	None	2.5Y6/4	.1730	5.41	-3.23	8.64	
Layer 3	9-19	2.8	None	2.5Y5/4	.1682	5.26	-2.54	7.90	
Layer 4	19-48	2.6	None	2.5Y5/4	.2462	7.69	-4.15	11.84	
DA 1504 Pit # 1									
Layer 1	0-4	3.1	None	10YR6/4	.0950	2.97	-2.31	5.28	

TABLE 35

ACID-BASE ACCOUNT OF DISPOSAL AREA PITS

Divide Section - Tennessee Tombigbee Waterway

						$CaCO_3$ Equivalent Tons/1000 Tons Material			
Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
Layer 2	4-25	2.8	None	2.5Y6/2	.5013	15.69	-6.92	22.59	
Layer 3	25-32	3.1	None	2.5Y6/2	.1306	4.08	-2.08	6.16	
Layer 4	32-42	4.3	None	2.5Y5/2	.3390	10.59	- .46	11.05	
DA 1704 Pit #1									
Layer 1	0-1	3.5	None	2.5Y6/3	.1629	5.09	-6.10	11.19	
Layer 2	1-8	3.7	None	2.5Y6/2	.1177	3.68	-4.22	7.90	
Layer 3	8-19	3.8	None	2.5Y6/2	.3016	9.43	-4.69	14.12	
Layer 4	19-31	4.5	None	2.5Y6/4	.0143	.45	- .70	1.15	
Layer 5	31-42	4.9	None	5Y6/2	.0319	1.00	- .23	1.34	
Layer 6	42-48	5.4	None	5Y6/2	.0173	.54	.94		.40

various textures and densities contribute to more low tension (plant available) water. Only in continuous sand or loamy sand textures that are free from contrasting materials should moisture stress present a problem. Physical impediments to root penetration are small because continuous high density layers are not present. Roots are active in samples that show an excess of neutralizers, but diminish growth when reaching an acid-toxic layer.

Table 36 shows the same trends regarding nutrient status that are reported in the discussion on previous disposal areas. Values for potassium, magnesium and phosphorus are high in the disposal area soils deposited from the typical Eutaw beds. These high values are not from initial fertilizer applications because they are present below the incorporation depth. In Table 36, the values of potassium, magnesium and phosphorus are reported for different depths. Pit number 1 on 1704, Layer 3 contains 1198 lbs/1000 tons (lbs/acre) of available magnesium which is a very high concentration. These levels of basic plant nutrients are present in the overburden and through accelerated weathering processes in an acid system, we have an "autofertilizing" phenomenon.

Identified in the overburden logs and the general geology of the area are greensand (glauconite) containing many of these basic plant nutrients as reported in the discussion on disposal area 1203. Commercial results detailing the chemical composition of this kind of material is as follows:

> "Greensand (Glauconite) is essentially a hydrated silicate of iron and potash. The potash is, however, insoluble in water and only slightly available as a fertilizer material without special treatment. The potash (K_2O_ content of 252 commercial samples varied from 4.15 to 9.54 percent, with a mean of 6.26. It also contains an average of 1.35 percent P_2O_5, 2.28 percent CaO, 2.73 percent Mg), 0.03 percent MnO and 0.138 percent B_2O_3 (Mehring, 1964)."

TABLE 36

NUTRIENT STATUS REPORT - DISPOSAL AREA PITS

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons K	Ca	Mg	Na
DA 1503 Pit #1							
Layer 1	0-3	4.6	49	198	5084	303	28
Layer 2	3-8	3.1	17	118	912	168	26
Layer 3	8-12	3.2	20	100	956	200	28
Layer 4	12-35	3.0	23	142	1938	574	40
Layer 5	34-45	3.2	21	126	2143	579	44
DA 1503 Pit #2							
Layer 1	0-4	3.6	162	378	4150	378	46
Layer 2A	4-9	2.9	24	142	2896	526	36
Layer 2B	4-9	2.9	35	132	2987	535	38
Layer 3	9-19	2.9	18	106	2554	515	46
Layer 4	19-48	2.7	16	116	2987	690	46
DA 1504 Pit #1							
Layer 1	0-4	2.9	102	72	1892	116	33

TABLE 36

NUTRIENT STATUS REPORT - DISPOSAL AREA PITS

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
Layer 2	4-25	2.4	46	94	2782	832	45
Layer 3	25-32	3.1	23	138	1254	415	42
Layer 4	32-42	4.0	21	210	3192	809	55
DA 1704 Pit #1							
Layer 1	0-1	2.5	12	90	810	152	14
Layer 2	1-8	2.6	8	44	1350	276	18
Layer 3	8-19	2.7	7	148	2106	1198	22
Layer 4	19-31	3.9	16	230	972	318	38
Layer 5	31-42	3.6	9	150	918	432	22
Layer 6	42-48	3.9	17	164	702	232	22

In the USSR, Russian reclamation specialists were using greensand (glauconite) for plating material at a phosphorite mine south of Moscow (Ammons, 1979). The glauconite was present as a parting between the phosphorite ore but contained no pyrite. Use of this plating material improved reclamation success with a predominantly sand overburden. Some deposits of greensand are mined for fertilizer in New Jersey and Virginia.

Liming disposal areas originating from typical Eutaw beds and incorporation to at least eight inches should sustain vegetation. Once vegetation is established, a reduction in oxidation is realized through increased levels of carbon dioxide in the root zone. With increased levels of carbon dioxide, decreased levels of oxygen reduce oxidation. Increased levels of carbon dioxide also solubilize added neutralizers offsetting additional acidity produced by oxidation of pyrite.

TABLE 37

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA PITS

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
DA 1504 Pit # 1							
Layer 1	0-3	4.6	.17	36	.7	6.6	119
Layer 2	3-8	3.1	3.20	19	.8	2.1	185
Layer 3	8-12	3.2	2.50	24	.7	4.2	96
Layer 4	12-35	3.0	2.49	97	1.1	9.6	318
Layer 5	35-45	3.2	1.09	99	1.2	9.2	660
DA 1503 Pit # 2							
Layer 1	0-4	3.6	1.35	88	1.2	9.8	384
Layer 2A	4-9	2.9	3.38	140	1.0	5.7	372
Layer 2B	4-9	2.9	3.51	145	1.1	5.7	396
Layer 3	9-19	2.9	3.64	148	1.0	3.5	331
Layer 4	19-48	2.7	4.78	186	4.3	14.2	516
DA 1504 Pit # 1							
Layer 1	0-4	2.9	4.70	11	1.0	4.4	343

TABLE 37

MICRONUTRIENTS, KCl EXTRACTABLE ALUMINUM AND 1:1 pH OF DISPOSAL AREA PITS

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
Layer 2	4-25	2.4	5.84	137	1.5	12.0	1069
Layer 3	25-32	3.1	2.42	40	.8	5.7	114
Layer 4	32-42	4.0	.63	196	1.2	5.6	625
DA 1704 Pit # 1							
Layer 1	0-1	2.5	4.83	7	0.9	4.5	490
Layer 2	1-8	2.6	6.09	11	0.9	5.6	408
Layer 3	8-19	2.7	7.72	58	1.2	9.4	406
Layer 4	19-31	3.9	4.71	35	1.9	6.2	761
Layer 5	31-42	3.6	3.45	31	0.7	2.3	65
Layer 6	42-48	3.9	1.80	66	0.7	2.4	301

DA 1503 Pit # 1 Soil Profile Description

Site Location - see location map, Figure 10.

Classification (Field) - Matrix Udispolents, coarse-loamy, mixed, extremely acid, thermic (Tombigbee family)

Sampled and Described by - P. Shelton and J. Ammons

Layer 1 - 0-3 in; 2.5Y4/4 (olive brown) faint mottling; sandy loam; very weak granular structure due to roots; loose consistency; common very fine to fine roots; few to common fine flakes of mica; pH 6.5.

Layer 2 - 3-8 in; 2.5Y4/4 (olive brown) with lithochromic mottling gray; 2.5Y4/0 (dark gray); few high chroma yellowish mottles; fine sandy loam; structureless single grain; very fine roots; mica is common and fine; pH 4.

Layer 3 - 8-12 in; 2.5Y6/6 (olive yellow); sandy loam; very friable consistency; structureless - single grain; few very fine roots; few very fine flakes of mica.

Layer 4 - 12-35 in; mottled 2.5Y4/0 (dark gray) and 7.5YR5/8 (strong brown), 2.5Y5/4 (light olive brown); sandy clay loam to heavy loam; friable consistency; structureless massive; no roots; many fine to medium flakes of mica.

Layer 5 - 35-45 in; N/4 (dark gray); fine sandy loam; friable consistency; structureless single grain structure; no roots - common very fine mica flakes.

DA 1503 Pit # 2 Soil Profile Description

Site Location - see location map, Figure 10

Classification (Field) - Matrix Udispolents, coarse-loamy, mixed, extremely acid, thermic (Tombigbee family)

Sampled and Described by - P. Shelton and J. Ammons

Layer 1 - 0-4 in; 10YR5/4 (yellowish brown) mottled (few) with 10YR4/2 (dark grayish brown); very fine sandy loam; granular (weak); loose; many fine and very fine roots; many fine and very fine mica flakes.

Layer 2 - 4-9 in; matrix 2.5Y5/4 (light olive brown) with few mottles of 2/5Y4/0 (dark gray) and 5YR5/8 (yellowish red); very fine sandy loam; very friable; massive structure; common fine and very fine roots; many fine and very fine mica flakes.

Layer 3 - 9-19 in; matrix 2.5Y5/4 (light olive brown) with few mottles; 2.5Y7/2 (light gray); 7.5YR5/8 (strong brown), 10YR3/1 (very dark gray); very fine sandy loam; very friable; structureless massive and rock controlled; very, very few roots; many fine mica flakes.

Layer 4 - 19-48 in; matrix of 10YR6/8 (brownish yellow) and 10YR5/6 (yellowish brown) mottled with 2.5Y7/2 (light gray), 7.5YR5/8 (strong brown) very few 10YR3/1 (very dark gray); very fine sandy loam; very friable; structureless massive, some rock controlled; no roots; many very fine to fine mica flakes.

NOTE: Mudstone intact in place 2.5Y3/0 (very dark gray).

NOTE: Below 48 is high chroma loamy-sand texture.

DA 1504 Pit # 1 Soil Profile Description

Site Location - see location may Figure 10.

Classification (Field) - Matrix Udispolents, coarse-loamy, mixed extremely acid, thermic (Tombigbee family)

Samples and Described by - P. Shelton and J. Ammons

Layer 1 - 0-4 in; 2.5Y6/4 (light yellowish brown) mottles; very fine loamy sand; massive single grain; weak granular; many very fine and fine roots (dead); many very fine to mica flakes; pH below 4.
NOTE: Top inch very fine sandy loam material which is very loose, bottom three friable.

Layer 2 - 4-25 in; 2.5Y4/2 (dark grayish brown), 2.5Y3/1 (very dark gray to grayish brown), 10YR6/8 (brownish yellow) mottled; loam to sandy clay loam; friable; in places near mudstone - induced weak to moderate plating; rest is structureless massive; no roots; pH below 4; boundaries clear and wavy.

Layer 3 - 25-32 in; mottled color 6/8 (brownish yellow) and 10YR4/1 (dark gray); very fine sandy loam; friable; structureless, rock controlled relicate structure; no roots; many very fine to fine mica flakes; pH below four; clear wavy boundary.

Layer 4 - 32-42 in; 5Y4/1 (dark gray); very fine sandy loam; friable consistency; structureless massive - rock controlled relicate structure; no roots; very many fine to fine mica flakes; pH 6.5; boundary clear and wavy.

*Note: Roots are concentrated in the 0-4 inch layer.

DA 1/04 Pit 1 Soil Profile Description

Site Location - see location map, Figure 11.

Classification (Field) - Matrix Udispolents, coarse-loamy, mixed, extremely acid, thermic (Tombigbee family)

Sampled and Described by - J. Ammons and D. Clendenon

Layer 1 - 0-1 in; 2.5Y5/4 (light olive brown) matrix; 7.5YR5/8 (strong brown) 10YR6/1 (gray) mottled; very fine sandy loam *; weak granular structure; very friable consistency; pH less than 4; boundaries clear and wavy; very few very fine and fine roots; many very fine and fine mica flakes.
NOTE: * texture greasy by feel, **** carbonized wood partially replaced with mica.

Layer 2 - 1-8 in; 2.5Y5/2 (grayish brown), 10YR6/8 (brownish yellow) matrix; 7.5YR5/8 (strong brown), 2.5Y7/2 (light gray) mottles; loam *; structureless massive **; very friable consistency; pH less than 4; boundary clear and wavy; few waterworn quartz gravels; few very fine roots; many very fine and fine mica.
NOTE: * texture greasy by feel, ** structure controlled by mudstones weathered or loosely consolidated coarse fragments.

Layer 3 - 8-19 in; mottled 2.5Y4/2 (dark grayish brown), 2.5Y7/2 (light gray), 5Y5/8 (yellowish red) matrix; 2.5Y5/4 (light olive brown) mottles; fine sandy loam; structureless massive **; friable to firm consistency; pH less than 4; boundary clear and wavy; no roots; common very fine and fine mica; pockets of sandy loam 7.5YR5/8 (strong brown).
NOTE: ** structure controlled by mudstones weathered or loosely consolidated coarse fragments.

Layer 4 - 19-31 in; 5G4/1 (dark greenish gray) matrix; sandy clay; structureless massive; very firm consistency; pH 6.5; boundary abrupt and wavy; no roots; common very fine mica; pockets of sandy loam 5YR5/8 (yellow red), 2.5Y5/2 (grayish brown).
NOTE: *** appears highly compacted mudstone material (gray).

Layer 5 - 31-42 in; mottled 7.5YR5/8 (strong brown), 5G5/2 (grayish green) matrix; 5Y6/4 (pale olive) mottles; sandy loam; structureless massive **; very friable consistency; pH less than 4; boundary clear and wavy; no roots; laminae of finer material (gray) few very fine mica.
NOTE: ** structure controlled by mudstones weathered or loosely consolidated coarse fragments.

Layer 6 - 42-48+ in; 5G4/1 (dark greenish gray) matrix; sandy clay loam; structureless massive; firm consistency; pH 5.5; no roots; pockets of mottled 2.5Y4/2 (dark grayish brown), 2.5Y6/2 (light brownish gray) fine sand.

R E S U L T S   A N D   D I S C U S S I O N

V E G E T A T I O N   S T U D I E S

VEGETATION STUDIES

Disposal Area Fields

Disposal Area 1504

DA 1504 is divided by a field road located on a terrace running north and south, approximately parallel to the waterway. The portion of the area that is east of the terrace road has two distinct vegetation zones. The portion of DA 1504 on the west side of the terrace road has a small grove of transplanted trees on the south end. The remainder of the west side of the area has scattered plants. The plants are clustered around low spots that retain surface water. Figure 10 is a map of DA 1504 and DA 1503 showing locations of soil sampling. Figure 22 is a map of vegetation distribution and relative abundance in July, 1982.

Observations on Vegetation

The plant life on DA 1504 was observed several times from April 1981 to December, 1982. The changes observed between the July, 1981 and July, 1982 are discussed below. Refer to Figure 22 for a vegetation map of DA 1504 in July, 1982. The map is divided into sections 01, 02 and, 03. A list of 44 plant species encountered on disposal areas is included in Appendix G.

Section 01 of the DA 1504 remained essentially the same in percent of ground cover and in estimated vigor of vegetation made by visual observation. Sericea lespedeza was the predominant plant species in section 01. Weeping lovegrass, bahiagrass and common lespedeza are

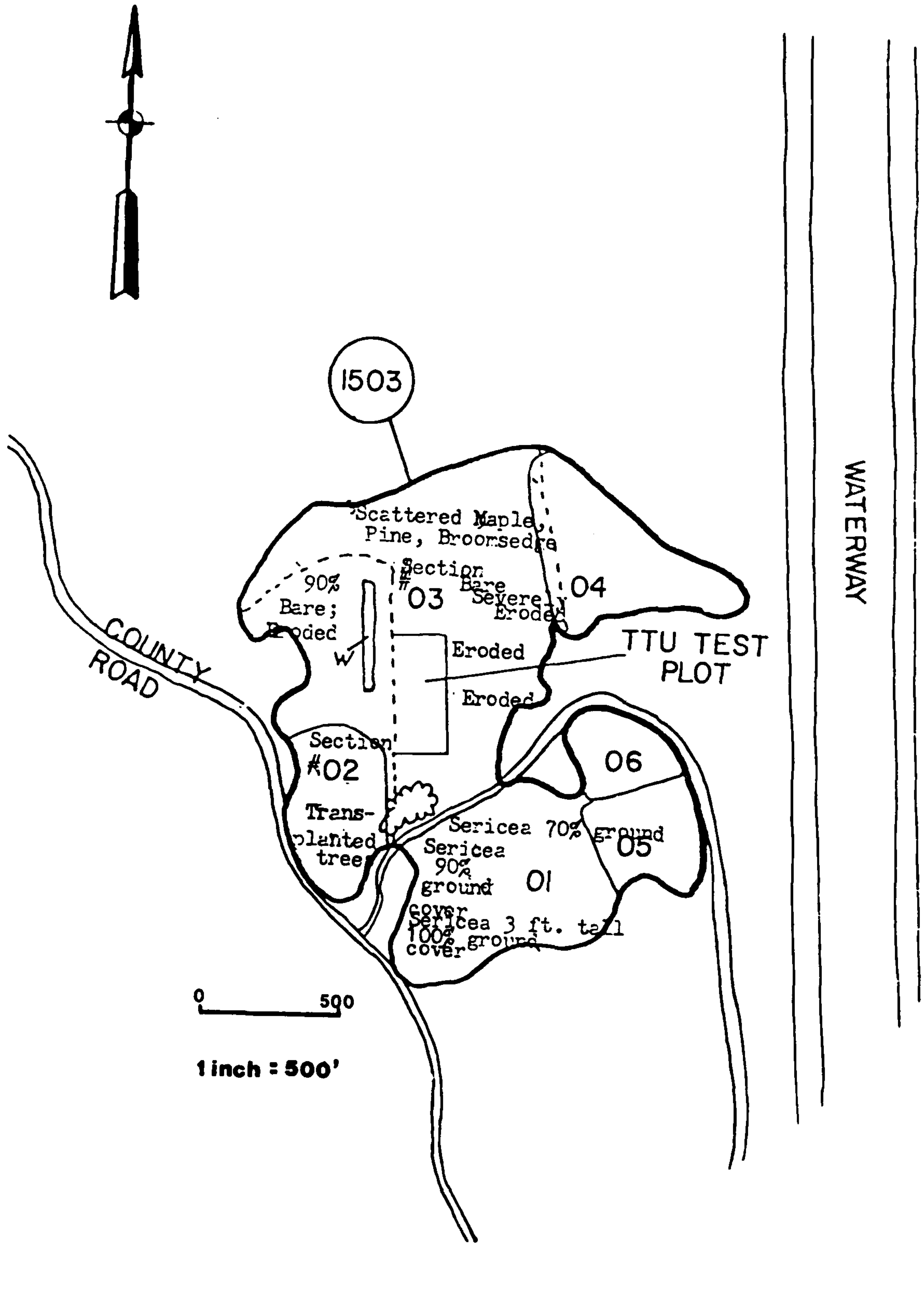

Figure 22. Vegetation evaluation on disposal area 1504, July, 1982.

present in the section. The sericea was well nodulated and its growth was vigorous, reaching 1 m in height. This area generally had excess neutralizers as evidenced by the Acid-Base Account, samples A-E (Table 12).

Section 02 has trees transplanted in 1980 on the south portion near the native soil and forest. The north portion of section 02 was essentially devoid of plants except around the water pond. Chemical analysis of the soil in section 03, (Figure 10 and Tables 12-14) showed a high level of KCl extractable aluminum, low pH, and a deficiency of neutralizers as great as 27 tons/acre $CaCO_3$ equivalent in the 0-4 inch depth (Sample K1).

Vegetation in section 03 of DA 1504 decreased drastically in vigor and in percent of ground cover from April, 1981 to July, 1982. In 1981, the gradient of increasing vegetation was along a line from SW to NE, with about 10% cover near the terrace road to 50% cover on the extreme NE end. Many dead residues of tall fescue and other grasses were present in 1981. Plant cover declined to near zero by mid 1982. Severe erosion has dissected section 03. Land shaping will be required before revegetation can be attempted. Soil analysis results for the section were low pH (below 4 in most samples), high levels of KCl-extractable aluminum, and deficiency in neutralizers (Table 12), (Observations on the test plots in DA 1504 are in a later section).

Generalizations

Disposal area 1504 is a good example of the diversity in conditions that exists in contiguous fill soil in a disposal area on the project. The level of success in establishment of vegetation varied widely from

section to section within a disposal area. A heterogeneous field such as DA 1504 can not be vegetated successfully without the aid of soil analyses to indicate the immediate requirements for lime and the amount of acid forming material present in the rhizosphere.

The approach to revegetation of sections that failed to sustain vegetation should vary with the results of the soil chemical analysis of each section, the extent of erosion in the section, and the size of the section where vegetation failed. Management techniques of sections where vegetation persisted will vary with the agency's goals for the disposal area in the future.

Disposal area 1504, section 01, is under stable vegetation. For future maintenance, liming over the soil surface is probably the only treatment needed to maintain plant cover in the present amount. Nitrogen from nodulation is supplied in adequate amounts to sustain the sericea lespedeza where sericea makes up all of the plant cover. Sufficient N is also supplied by the sericea where sericea and grass exist in a mixed sward. The nutrient elements P and K are present in sufficient amounts in the soil to sustain vegetation on the section without addition of fertilizer. In order for the P and K in the soil to be beneficial to the plants, sufficient lime must be applied periodically so that the P and K will remain available to the plants.

Section 02 should be treated with sufficient lime incorporated to eight inches to meet the lime requirement calculated in the Acid-Base Account. According to the seeding test results on DA 1504, lime should also be placed on the soil surface to insure the root environment required by newly germinated seedlings. The seeding mix that is appropriate to the season in which it is planted should be seeded. Mulch

should be applied and crimped to prevent erosion of the seed bed. Seeding procedures are discussed in the section with the seeding mixes under Recommendations.

Disposal Area 1503

This area was surveyed for plant abundance and vigor in July, 1981, May, 1982, and July, 1982. The warm season species were observed in July and cool season species and perennial warm season species were observed in May. A map of soil sampling locations is in Figure 10. Figure 23 is a vegetation may of the area for May-July, 1982.

In 1981, sections 06 and 07 of DA 1503 (sections closest to railroad) were predominantly weeping lovegrass. Wheat was second in abundance and sericea lespedeza was third. The lovegrass averaged 12 inches in height. Ground cover, height, and color of the lovegrass varied from site to site apparently in response to the moisture conditions. Increasing soil moisture was related to improved stand, height, and vigor. Shallow root mats (2" deep) were observed in sites with dead plants in section 04. Dead areas were as large as one fourth acre.

In sections 02, 03, and 05 cereal rye made up nearly 100% of the ground cover. The rye was vigorous and in full seed head in July, 1981. In May of 1982, 27 species of plants were observed in sections 01-06 of DA 1503.

The plant species composition encountered on DA 1503 in May, 1982 was extremely diverse. A list of the plants follows:

Common ragweed	Cudweed	Cheat
Cutleaf evening primrose	Dock	Broadleaf
Curley leaf	Dogfennel, giant	Erechtites
Goldenrod	Hair grass	Lambsquarter

Lespedeza, bicolor	Lespedeza, sericea	Little barley
Lovegrass, lehman	Lovegrass, weeping	Marestail
Millet	Orchardgrass	Paspalum
Rye	Ryegrass	Smartweed
Vervain	Virginia pepperweed	Wheat
Wild lettuce		

The herbaceous plants encountered on DA 1503 in May, 1982 are listed and identified by map section below: (See map in Figure 23).

Section 01

Cheat
Cutleaf evening primrose
Lespedeza, bicolor

Section 02

Common ragweed
Dock
-Broadleaf
-Curley leaf
Lespedeza, sericea
Virginia pepperweed

Section 03

Goldenrod

Section 04

Cudweed
Dogfennel, giant
Erechtites
Lambsquarter
Little Barley
Marestail
Millet
Orchardgrass
Paspalum
Ryegrass
Smartweed
Vervain
Wheat
Wild lettuce

Section 06

Lovegrass, lehman
Lovegrass,weeping

Section 07

Hairgrass

All sections

Rye

Numerous species of woody plants were located on the periphery of DA 1503. Some of these were sumac, persimmon, red maple, elderberry, blackberry, and greenbriar.

This great diversity of species that invaded the area since July of 1981 indicates that very meaningful ecological shifts in plant populations had taken place. Some of the species that invaded the area, such as lambsquarter, indicate that available plant nutrient status was very high. The presence of smartweed and dock indicate that moisture supply in this soil is abundant. Many of the species are annuals. This is expected in the early phase of plant succession of a disturbed land site.

In July of 1982, other species were encountered in sections 01-06. Fall panicum, broomsedge, cocklebur, cassia and sericea lespedeza were present. New sericea seedlings were observed in circles surrounding a few mature sericea plants in section 02. The lovegrass which was predominant in the area in 1981 was mostly dead in July, 1982. The pH (Table 12) in sections 04, 06, and 07 where the lovegrass was prevalent dropped to below 3.0 before additional lime was added in July, 1981.

An important implication on the influence of N fertilizer on species composition was observed in sections 03 and 04. Marestail has invaded tall fescue more than sericea lespedeza has invaded the fescue. Fertilizer N may be responsible for the greater success of the marestail in this case. Observations over a period of several growing seasons would be required to draw specific conclusions from the observation. DA 1503 presents an excellent example of species invasion into an area in the early stages of plant succession. The area should be maintained under a program of minimum disturbance for three to five years in order that the maximum amount of information can be gained on plant succession

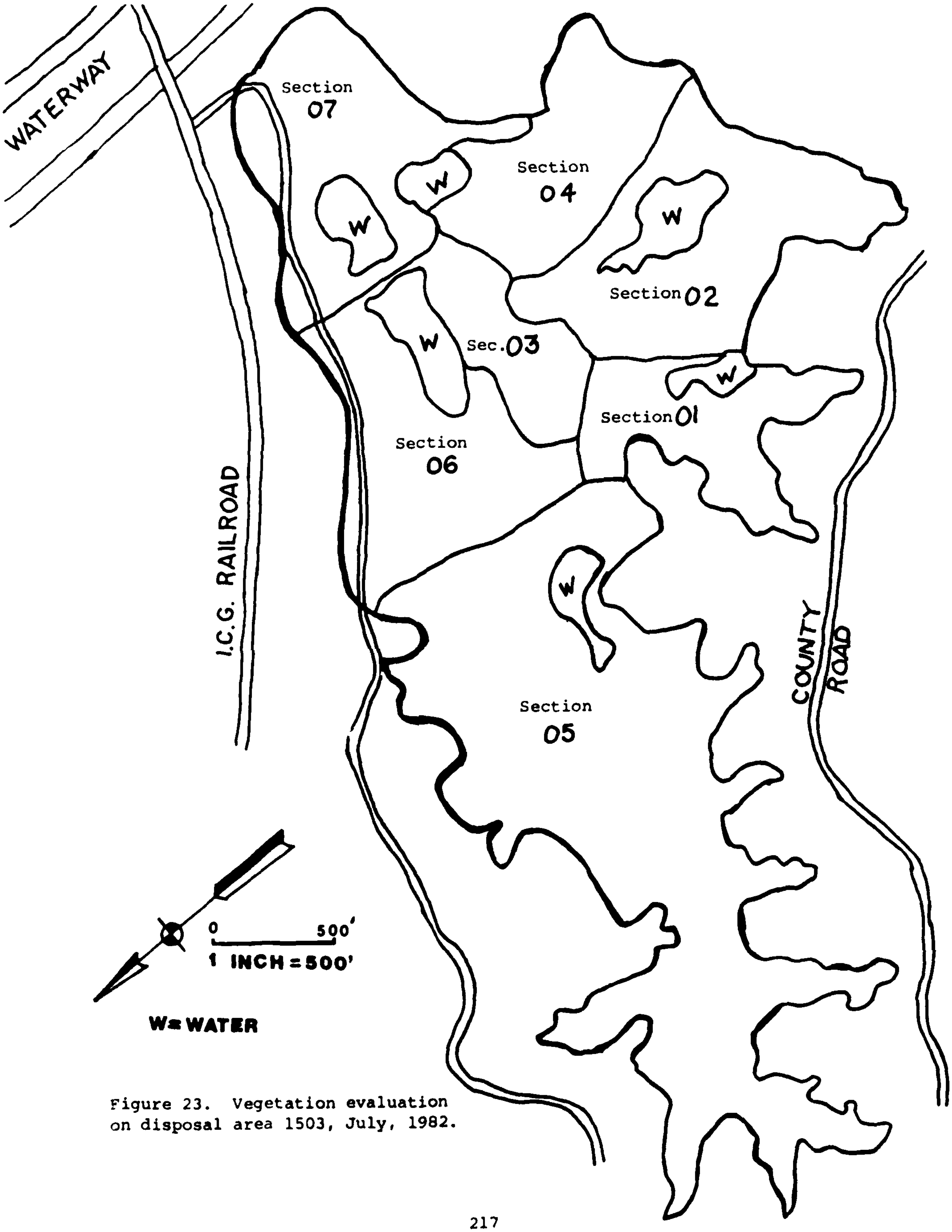

Figure 23. Vegetation evaluation on disposal area 1503, July, 1982.

patterns on the waterway project. DA 1503 is the best area of those observed in this project for a continuing study of plant succession.

Disposal Area 1704

Vegetation distribution, species, stand composition, height and vigor were observed in July and December, 1981 and in May and July, 1982. The area was burned in December, 1981 as part of the tree planting program. Figure 24 is a vegetation map as of July, 1982. Data from soil samples taken from DA 1704 in May, 1982 are reported in Figure 11 and Tables 18-20. DA 1704 and DA 501 are the two fields in the project that have been seeded for the longest period of time.

There were several plant species present in the area in December, 1981. Tall fescue was dominant in overall abundance. Bahiagrass plants tended to occur more often than other species in the north portion of the mid slope (section 01 in Figure 24). Weeping lovegrass was the most abundant species in section 04 which is between the waterway and the creek on the SW side of DA 1704. Scattered plants (one per 500 sq. ft.) of broomsedge had invaded at random over the disposal area. Switchgrass, red sorrel, red clover, sericea lespedeza, and winter annual broadleaf plants were found in scattered distribution. Annual vetch (hairy) had invaded tall fescue stands on knolls along the border between sections 01 and 02. The vetch was established in scattered (one per acre) dense clumps. The vetch had abundant nodules. A *Panicum* species similar to Scribner's was found in wet areas. Dead stalks of annual warm season grasses, including foxtails and crabgrass, were present. A few woody species were in the open fields and were abundant along the creek. Sericea lespedeza was present in sufficient density to provide 100% ground cover on the SE periphery of the area.

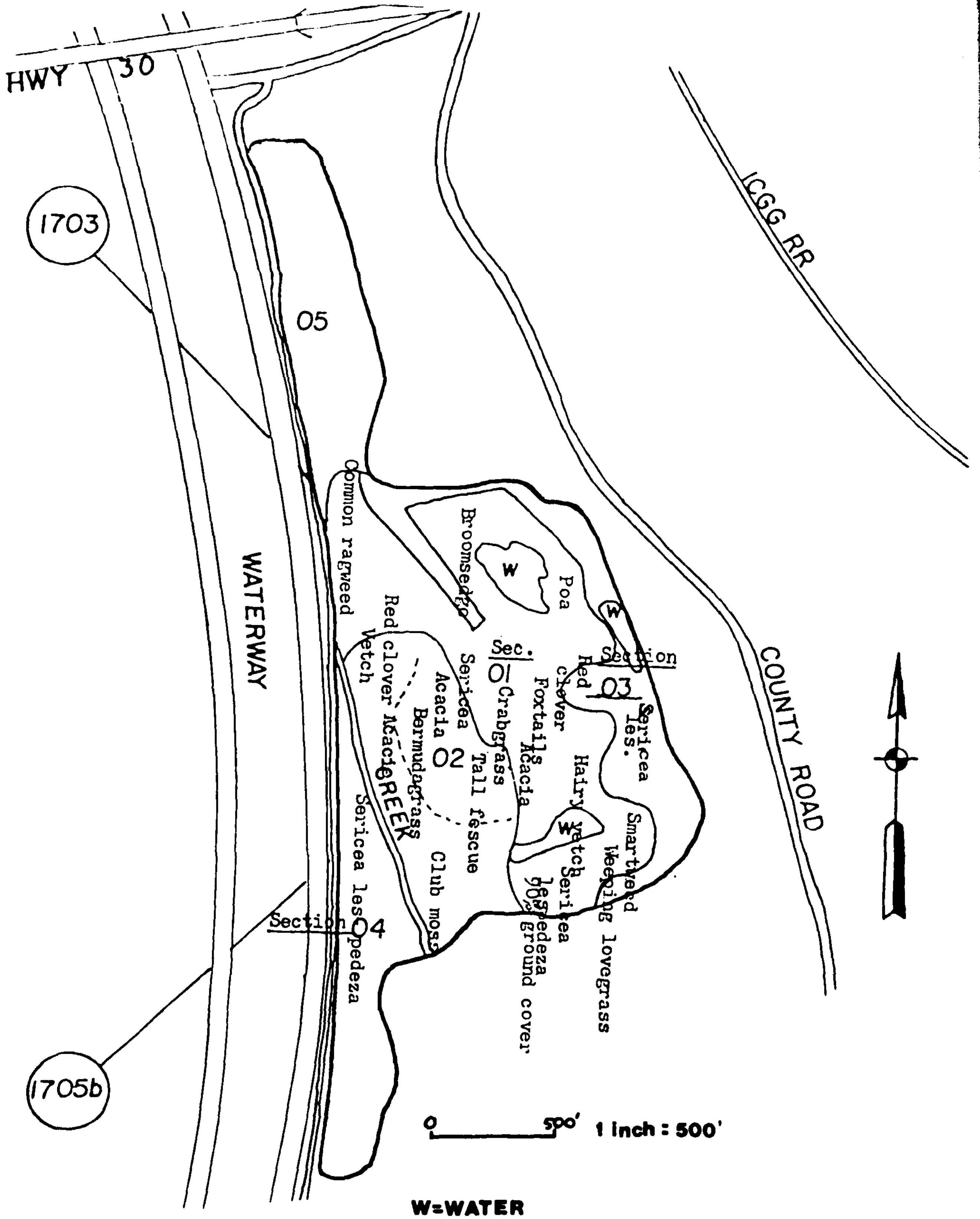

Figure 24. Vegetation evaluation on disposal area 1704, July, 1982.

In July, 1981, seven months after burning and tree seedling planting, the composition of herbaceous plants and invader species of woody plants had changed. The following shifts in vegetation were noted (see also Figure 24).

Section	Changes
01 (Mid)	Sericea, red clover, and deerstongue increased. Tall fescue decreased.
01 (South)	Cassia, and bicolor lespedeza, marestail, smartweed increased.
01 (North)	Broomsedge and bahiagrass increased.
02 (Above dike)	Cassia became dominant.
02 (Below dike)	Common ragweed, red clover, and cassia increased.
04	Sericea became dominant. Weeping lovegrass decreased.

The soils in DA 1704 have higher pH values and lower potential to produce acidity than the soils in other disposal areas studied (Table 18). On DA 1704 vegetation is in the early stages of succession. Leguminous species would normally increase if no N fertilizer were applied. Burning of the area modified the patterns probably only temporarily. Some annual dicotyledonous species invaded after burning. More erosion risks are encountered when burning rahtern than when desiccant herbicides are used to reduce the vigor of herbaceous vegetation.

Disposal Area 1204

This area was newly constructed when this study began in 1981. DA 1204 and DA 1203 were treated with 12 tons/acre of lime before seeding. Some "plating" was used on these areas. Acid-Base accounting (Table 21)

indicates that adequate neutralizers to offset potential acidity are present at the 0-4 inch depth in 16 of 17 sampling sites (Figure 12). Site J had a deficiency of neutralizers at the surface.

Figures 25 and 26 are vegetation maps of DA 1204 on May 22, 1982 and July 14, 1982, respectively. Six sections (01-06) are identified on the maps of DA 1204. Most of the area (sections 02, 03, 05) was seeded to cereal rye in the fall of 1981. Lime was applied after cereal rye and fescue were cut on May 10, 1982. The rye formed a complete ground cover in the winter and spring of 1982. The rye yielded approximately 3t/a of dry forage when harvested the second week of May, 1982. In the north side of sections 02, 03, and 05 the rye was seeded over tall fescue. Section 01 had 100% ground cover by tall fescue in May, 1982. The fescue was two feet tall in May and was clipped in June, 1982. Section 04 of DA 1204 is a terraced section on the east side of the area. In May the species most often encountered in section 04 along a line transect from NW to SE were tall fescue, bermudagrass, weeping lovegrass with sericea lespedeza and annual broadleaf weeds each appearing approximately one per 30 meters. The bermudagrass and lovegrass plants were weak to dead. In Section 06 in May there were 1 to 5 sericea lespedeza plants per square meter. Bermudagrass, annual grasses and broadleaf species were present along the margins of the impounded water sites in sections 01 and 06 in May.

In July some changes in vegetation distribution and composition were noted, mostly in section 04. Bahiagrass formed approximately 90% ground cover in small (20 x 20m) patches and 10 plants per sq. m of sericea lespedeza were present in small colonies (100 sq. m). Chloris (grass) and specimens of sprangletop were present in section 04.

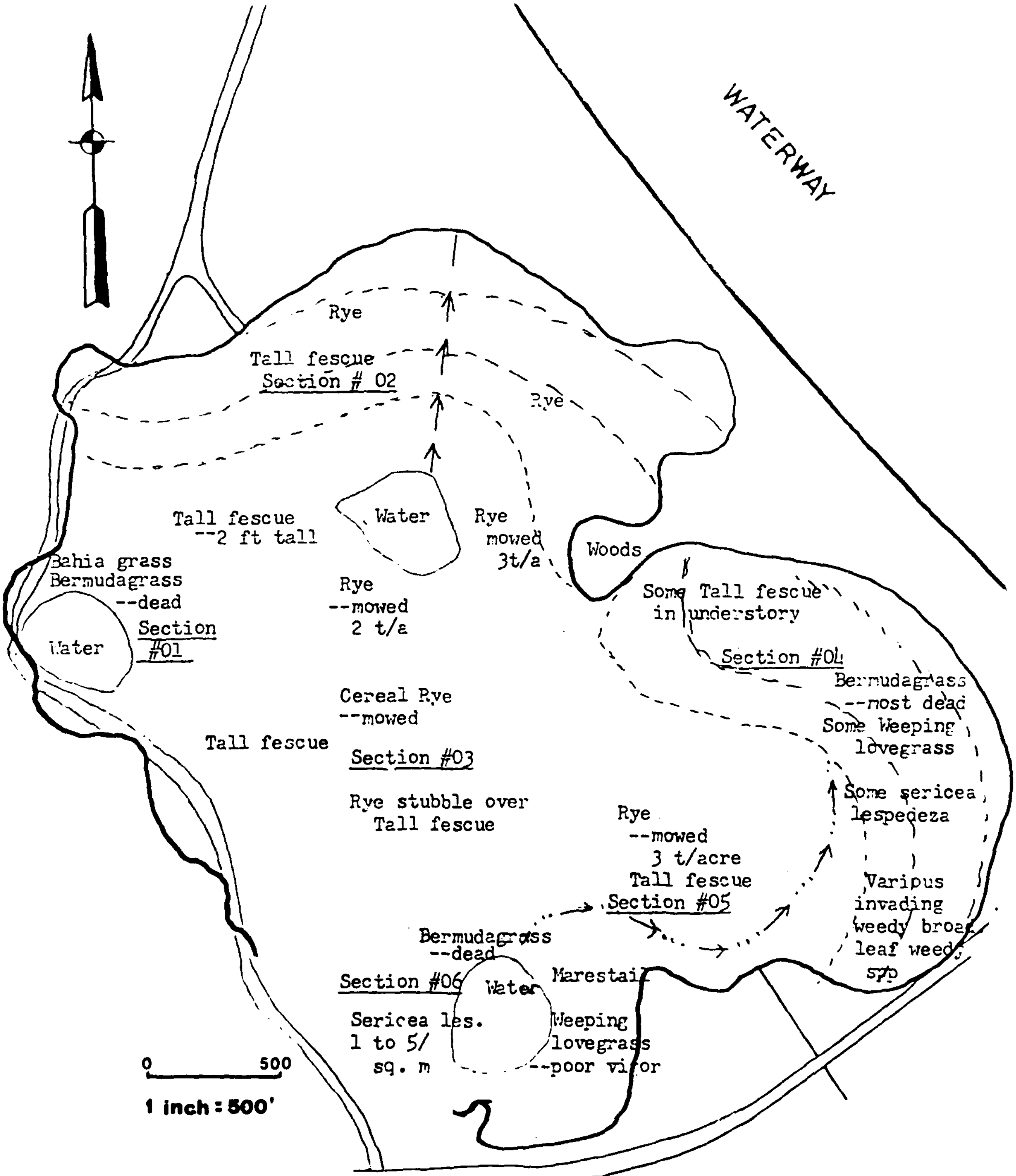

Figure 25. Vegetation evaluation on disposal area 1204, May, 1982.

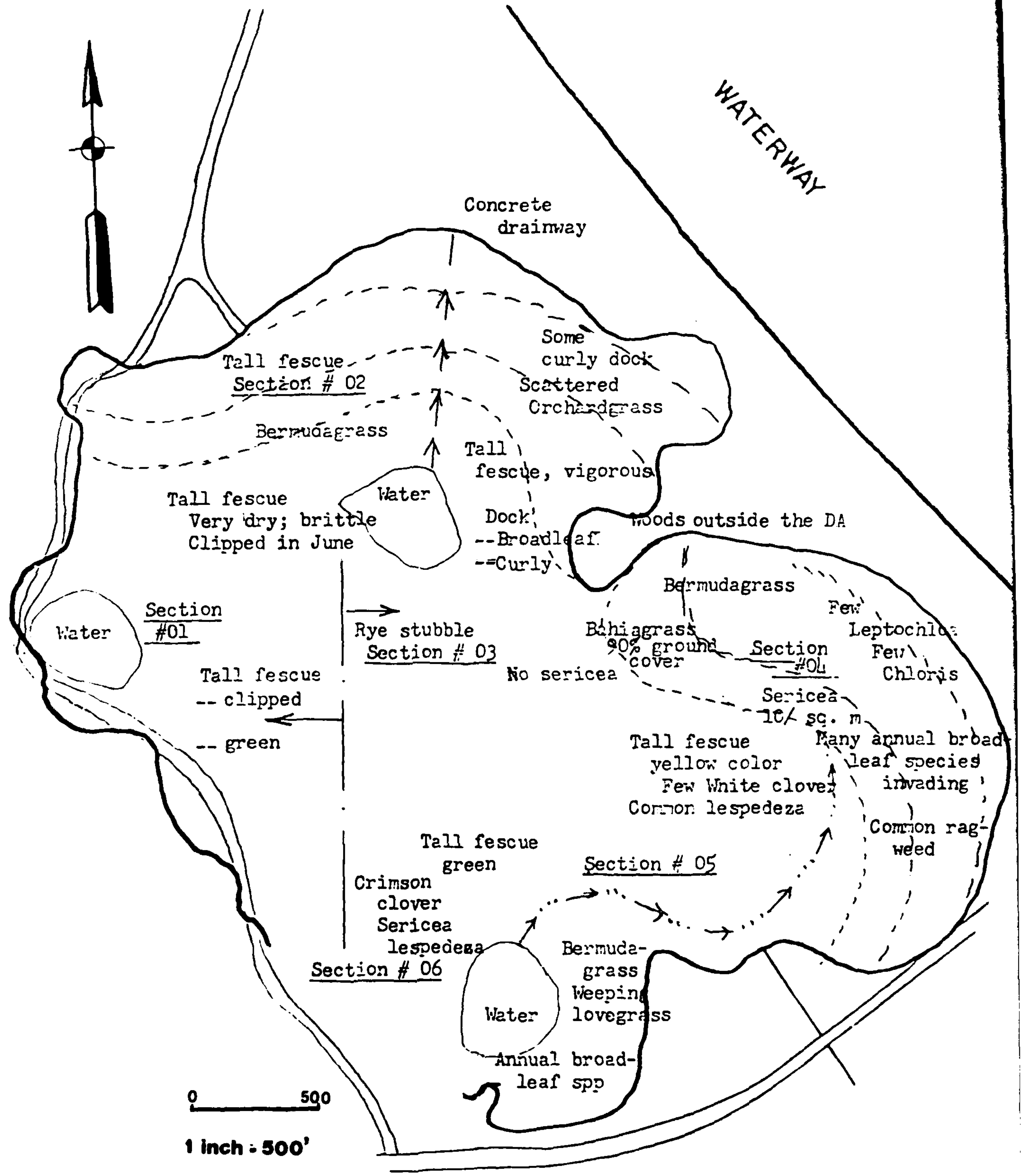

Figure 26. Vegetation evaluation on disposal area 1204, July, 1982.

The composition of the herbaceous plant species in DA 1204 will continue to change for several years and will eventually be replaced by woody species. This area is an excellent site for observing plant succession patterns on the waterway project. Data should be collected on cool season and warm season species each year until woody species invade and dominate the area. The changes in association of herbaceous and woody species should be observed and mapped until the woody species become dominant.

The conditions in DA 1203 are very similar to those in DA 1204. Laboratory soil analyses indicate that sufficient neutralizers are present to offset potential acidity from oxidizing pyrite (Table 24). The succession patterns in vegetation on DA 1203 should be observed and mapped until woody species become dominant as in DA 1204.

Disposal Area 501

The soil in this disposal area is similar to DA 1704 in its nutrient status (see discussion of DA 1704). The area has been limed extensively and was one of the first disposal areas in the project that was seeded. Some micronutrients were present in greater concentration in this disposal area than in others (Table 29). The relationship of KCl extractable aluminum to pH are the same as in other areas. In contrast with DA 1704, only a few species are present in DA 501.

Vegetation covers the entire disposal area with the exception of a few small sparsely vegetated spots. Observations were made on the vegetation on several dates in 1981 and 1982. The herbaceous vegetation was burned in December, 1981 before seedlings of eight woody species were planted in the eastern half of the area. As was true for DA 1704,

some erosion hazards could have been avoided by the use of a desiccant herbicide in place of burning to reduce herbaceous plant cover.

The success of woody species establishment should be observed for several years on DA 501 and DA 1704.

PLANT GROWTH RESPONSE TO LIMING RATES

Growth Chamber and Greenhouse Studies on Disposal Area Soils

The condition of vegetation was reviewed by field visits with corps personnel in several disposal areas in 1981. Various species of plants had been seeded on the disposal areas as the fill was completed and the surface shaped. Vegetative cover on the seeded areas varied from 100% potential to near zero or bare ground. Where vegetation seeding had failed and where vegetation had established and regressed, erosion began quickly and progressed rapidly. Surface reshaping and revegetation was necessary on some disposal areas.

Among the disposal areas reviewed the level of success in establishing vegetation ranks from high to low in the following order: 1704 - 501; 1203 - 1204; 1503; 1504.

Soil samples from multiple locations in each disposal area above were analyzed in the laboratory (Tables 12-29). Soil profile descriptions were made in areas 1503, 1504 and 1704. Root abundance and depth of root penetration were included in the profile description. Field notations of root abundance are included in the sampling logs for disposal areas 1203, 1204, 501 and 1704 (Appendix D).

Five studies were conducted in the growth chamber and greenhouse on soil samples from typical sites where vegetation failures were prevalent. The soils used in these studies were treated with various rates of lime, chemically analyzed, and placed in plant pots. The soils were seeded with four species of grasses and legumes. The environmental conditions required for growth by each species were maintained.

Seeds of one grass and two legumes were germinated on the surface of limed and unlimed soils from the waterway disposal sites.

Growth Chamber Studies of Plants

Plant growth responses of weeping lovegrass and sericea lespedeza to five liming rates were studied in the growth chamber at Tennessee Tech University. These two species and crimson clover were tested for germination success and seedling establishment. Lime rates of 4, 8, 16, 32 and 64 tons per 1000 tons of field soil were applied in DA 1504. Rates were replicated four times. Lime was incorporated into the surface 0-12 inch soil zone. Samples were taken from the full depth of incorporation. Each sample was mixed thoroughly to distribute the lime uniformly.

The samples of treated soil were placed in pots with clear plastic liners, water was added to 90% field capacity of the soil, and seed was placed on the surface and pressed into contact with the moist soil. The clear plastic liners were closed over the top of each pot and the pot placed into a growth chamber for seed germination. No additional fertilizer was applied.

The germinated seed were counted and observed for abnormalities. The plastic liners were folded down after seed germination and the plants were cultured under precise climate control conditions for ten weeks (10 hours light at 31°C (88°F) and 14 hours light at 21°C (70°F); relative humidity was 80% in light and 90% in dark).

Specific germination and growing conditions were selected for the plant species under study. At the end of the plant growth test with weeping lovegrass, the soil was allowed to dry until the plants died of moisture stress. The dead plants tops were clipped at the soil surface

and removed. After the soil was moistened, seeds of sericea lespedeza were planted in the pots previously occupied by the weeping lovegrass. No fertilizer was added to the pots.

Growth of the weeping lovegrass and interstate sericea lespedeza plants was observed under growth chamber conditions. The height measurements are given in Table 38. The measurements can be compared only among lime treatments within a species because growth potential varies among species. Each measurement is the average of four replications (4 different pots).

TABLE 38

PLANT HEIGHT OF WEEPING LOVEGRASS AND SERICEA LESPEDEZA IN FIVE LIME RATES

Measurement made 60 days after Emergence

	Liming Rate (t/1000t)				
	4	8	16	32	64
Weeping Lovegrass (cm)	30	43	61	51	53
Sericea Lespedeza (cm)	9	71	79	15	20
Soil pH	3.9	3.7	5.2	5.9	6.2

Greenhouse Study of Plants on Limed Disposal Soil

Soil samples from an untreated area on DA 1504 were collected, transported to the greenhouse, and treated with varying rates of lime. Multiple replications of the lime treatments were placed in tapered 6 - inch pots and a grass species and legume species were seeded in the pots in succeeding order. Each pot was placed on a catchment plate for retaining leachate from the pot. Minerals that were carried through the verticle profile of the soil in the pot accumulated in the catchment plate. The amount of leachate mineral material leached from soil of each lime treatment was compared with the unlimed control soil.

In preparation for the greenhouse study, disposal area soil was passed through a one-fourth inch mesh. The lime was passed through a standard 100 mesh screen. Five liming rates and an unlimed control treatment were used (Table 39). No fertilizer was added to the pots. The pots were watered 20 times in 60 days in order to allow the lime to react before the pots were seeded. Annual ryegrass was seeded in the pots on August 6, 1982. During the three months in which the plants were growing, water was withheld periodically until the plants indicated moisture stress and the soil was dry in the upper part of the pot. Succeeding watering carried salts out of the soil and into the catchment plate under the pot. Crimson clover was seeded in the pots after the annual ryegrass was removed. Results of the ryegrass study are presented in Table 39.

TABLE 39

RESPONSE OF RYEGRASS TO FIVE LIMING RATES
TO SOIL FROM DA 1504*

Liming Rate[1] T/1000T	Seed Germination	Plant Height @10 days	Plant Height @100 days	Leached Salt Accumulation
0	No	None	None	Present
2	No	None	None	Present
8	Yes	4"	9"	None

* Average of 4 replications

[1]Responses to rates 16, 24 and 32 were identical to those in rate 8. Uniformity of germination and plant height were evident among replications and lime rates except for the 2 ton rate in Rep I. Germination in this pot was erratic and the seeds that germinated died at 2 inches tall (before water stress was applied). Leached salt build-up occurred around the drains of all pots in the 0 and 2 ton rates. No salts leached out in liming rates of 8 tons or greater.

Seed Germination and Seedling Establishment on Disposal Area Soil Treated with Five Liming Rates

Weeping lovegrass, sericea lespedeza, and crimson clover seeds were placed on the surface of disposal area soils. Lime had been applied to the fields at rates of 4, 8, 16, 32, and 64 tons of lime per 1000 tons of soil. Untreated control soils from DA 1504 were included in this study for comparisons. Seeds of the three species were tested for germination at 22°C (72°F) ±1°C at 95% relative humidity for 7 days. The numbers needed to provide 24 pure live seed (PLS) per pot were used. There were four replications of each treatment. The complete test was repeated under the same conditions. The results are presented in Table 40. Seeds of all three plant species germinated on the surface of the lime treated soils and the unlimed control soils at the same rate as the seeds germinated under standard seed germination conditions. The overall average was 83%. Roots from seeds that germinated on the surface of the various treatments varied in the rate at which they penetrated the soil surface. No roots penetrated the soil in the unlimed control soils. The rate of success of seedling establishment also varied among liming rates.

TABLE 40

SEEDLING ESTABLISHMENT OF
THREE PLANT SPECIES ON DISPOSAL AREA SOILS AT VARYING PH

Seedling Count[1]

Soil pH	Weeping Lovegrass	Sericea Lespedeza	Crimson Clover	Three Species Average %
2.5 Control[2]	0	0	0	0
3.2 Control	0	0	0	0
3.3	0	0	0	0
3.4	7	0	3	14
3.5	0	0	0	0
3.6	8	7	10	35
4.1	18	15	20	74
4.2	20	6	17	60
4.8	20	20	20	83
5.1	20	12	20	72
5.3	15	20	20	76
5.6	17	15	20	72
5.8	20	12	20	72
6.0	20	16	12	67
6.2	20	15	20	76

Light	14 hr	14hr	9 hr
Temperature	30 C	30 C	22 C
Dark Temperature	26 C	26 C	13 C

[1]24 pure live seed were placed in each pot.

[2]KCl extractable Al in untreated disposal area soil samples averaged 5.6meq/100 g (n = 15; st. dev. = 3.07).

Plant survival counts 60 days after germination for the three plant species listed in Table 41.

TABLE 41

PLANT SURVIVAL AFTER 60 DAYS IN SOILS TREATED WITH FIVE LIME RATES
(from an original 24 pure live seed per pot)

	-----Liming Rate (t/1000t)-----					
	4	8	16	32	64	Control
Weeping Lovegrass	10	12	15	18	20	0
Sericea Lespedeza	9	5	11	13	15	0
Crimson Clover	10	4	15	15	16	0
Soil pH	3.9	3.7	5.2	5.9	6.2	3.0

Seedling survival varied with liming rate and pH of the soil. Aluminum mobility was high in these soils (Table 14). Sodium content in these soils was low (Table 13).

Summary

Seeds of three plants species germinated at a rate of 83 percent incubated in 95 percent relative humidity on the surface of limed and unlimed disposal site soil. The level of success of seedling establishment varied with the pH level to which to soils were adjusted by application and mixing with lime (Table 40). Seedling roots (radicles) did not penetrate the surface of soil samples when soil pH was 3.3 or lower. Root penetration of the soil was consistently successful when soil pH was above 4.0, which can be considered as approximately the point above which aluminum is not mobile.

Liming and Seeding Demonstration
Da 1504

Plant establishment was not uniform across replications of the various lime treatments applied to the field plots. This lack of uniformity of vegetative cover was determined to have been caused by the manner in which the lime was incorporated. Four months after the seeding date, field tests for the presence of free carbonates (Fizz Test) were made in two vegetated and two non-vegetated locations in each liming treatment. Results of the test are included in Appendix G. There were no free carbonates present in the 0-1" soil layer in 40 out of 40 locations where no vegetation established. In only 4 cases out of forty was there vegetation present where no free carbonates were present in the 0-1" soil layer. In all four of these cases free carbonates were present at depths of one to five inches. This points to the extreme importance of surficial lime to provide the conditions necessary for seedling establishment after germination. During the incorporation process on the demonstration plots, significant quantities of the applied lime were "flipped" underneath the turned soil, instead of being mixed into it. This accounts for the patchy distribution of the vegetation.

Mean vegetation ground cover for four replications and four seeding mixes was 17% in the 4 and 8 ton/acre liming rates. Mean vegetative cover in liming rates of 32 and 64 tons/acre was 55%. The sixteen ton rate resulted in a percent ground cover which was intermediate between these two values. Results of the vegetation evaluation are in Appendix G. Volunteer wheat emerged in many plots from seed in the mulch. Many

times more sericea lespedeza than crimson clover established in the plots.

The field demonstration was treated with a surface application of 3 tons of lime and 4 tons of mulch per acre on July 13, 1982 on the south half of each of the following replications and treatments:

LR 1, Replications 1, 2, 3, and 4
LR 2, Replications 1, 2, 3, and 4
LR 3, Replications 3 and 4

The southern half of each other plot in the demonstration was treated with on ton of lime per acre, but no mulch was applied (details are in Appendix G). Each part of the liming demonstration was overseeded with the same seeding mix used in the original seeding in 1981, except crimson clover was replaced with sericea lespedeza in 1982.

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APPENDIX A

Overburden Core Sampling and Description Logs

TENNESSEE TOMBIGBEE WATERWAY

U894A 44 CANS

15.2' ft to 118.1'

General Notes: 1. Complete Core To The Surface Is Missing. 2. All Samples Are Moist.
3. Colors Taken From Core Interior.

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
1 15.2' - 16.9'	2.5Y5/0 streaked 7.5Y5/8	Loam and sandy loam	None	Loosely consolidated sandy loam. Materials loosely consolidated. Shale. Common to many flakes of fine-medium size mica. Oxidation on core exterior.
2 17.5' - 19.0'	2.5Y3/0 very dark gray	Heavy clay loam	None	Thin bedded, loosely consolidated shale tending to be fissle in places. Mica common to many fine flakes. Oxidation on core exterior.
3 19.3' - 21.1'	2.5Y3/0 very dark gray	Heavy loam to clay loam	None	Some mudstone present. Less thin bedding. Oxidation on core exterior. Common to many fine flakes of mica.
4 21.4' - 23.3'	2.5Y4/0 dark gray	Loam to sandy loam	None	High moisture area. Soft mudstone with coarser material present. Oxidation on core exterior. Less bedding present, common to many mica flakes.
5 23.6' - 25.3'	2.5Y3/0 very dark gray	Sandy loam	None	Very few thin bedded planes. Loosely consolidated. Coarse grained - fine sand. Less mudstone present than above. Common to many mica flakes. Oxidation on core exterior.

US9-A 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
6 27.6' - 28.5'	5Y4/3 dominated by olive	Sandy loam	None	Loosely consolidated. Very few bedded mudstones present. Common to many mica flakes. Coarser texture. Oxidation on core exterior.
7 28.7' - 30.5'	2.5Y3/0 dominated by olive	Sandy loam	None	No mudstones. Few shale. Common to many mica flakes. Predominately coarse material. Weak laminations. Oxidation on core exterior.
8 31.0' - 32.9'	2.5Y3/0 very dark gray	Sandy loam	None	Few to common medium flakes of mica. Weak laminations. Coarse grained. Oxidation on core exterior.
9 34.8' - 36.7'	2.5Y4/0 very dark gray	Sandy loam	None	"sample shot by drilling rig" "loss H_2O core" Little evidence of thin bedded mudstone. Few to common medium flakes of mica. Oxidation on core exterior.
10 37.2' - 38.9'	2.5Y4/0 very dark gray with streaked 5YR5/8 yellowish red	Sandy loam	None	Common to many medium mica flakes. Oxidation on core exterior. Coarse texture. Few laminations.
11 39.0 - 48.8'	2.5Y4/0 dark gray	Sandy loam to loam	None	Very few laminations. Could be contaminated due to rigging complications. Oxidation on core exterior. Mica flakes few to common medium.

U894A 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
12 41.0' - 42.9'	2.5Y4/0 dark gray + 2.5Y3/0 very dark gray	Sandy loam to loam	None	Thin laminations of finer material. Mica flakes few to common medium. Oxidation on core exterior.
13 43.1' - 45.0'	2.5Yn/0 shale present 2/5Y3/0	Sandy loam	None	Laminations present. Shale present. Coarse textured.
14 45.1' - 47.0'	2.5Y3/0 very dark gray 2.5Yn/0 present	Loamy sand - sandy loam	None	Very coarse. Carb present. Oxidation on core exterior. Carb is believed to be sub-bituminous. Common medium size mica flakes.
15 47.2' - 49.1'	2.5Y3/0	Sandy loam - loamy sand	None	Laminated, with carb. Sandy sediments. Oxidation on core exterior. Coarse textured.
16 49.3' - 51.2'	2.5Y2/0 black on shale	Sandy loam - loamy sand	None	Laminated shale - fissle in some places. Oxidation on core exterior. Coarse textured. The laminated shale is dark gray; thin.

U894A 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
17 51.4' - 53.3'	2.5Y3/0 very dark gray	Sandy loam - loamy sand	None	Laminated shale material present. Oxidation on core exterior. Coarse textured. Carb present. Mica flakes fine to medium, common to many.
18 53.4' - 54.8'	2.5Y3/0 very dark gray	Sandy loam - loamy sand	None	Few to common medium mica flakes. Oxidation on core exterior. Thin bedded laminae. Some carb present.
19 55.1' - 57.1'	2.5Y$\frac{3 \text{ and } 2}{0}$ very dark gray-black	Loam to clay loam	None	Shale and fissle shale, dark. Mica common on bedding planes. Oxidation on core exterior.
	NO SAMPLE 57.1' - 64.6'			
20 64.6' - 65.9'	2.5Y4/0 dark gray	Sandy loam - loamy sand	None	Oxidation on core exterior. Large piece of paraffin found in sample. Very loosely consolidated. No laminations present. Heavily oxidized. Dominantly olive. Few medium size mica flakes.
	NOTE DEPTH CHANGES FOR CAN #20			
21 66.1' - 66.9'	2.5Y$\frac{3 \text{ and } 4}{0}$ dark and very dark gray	Sandy loam - loamy sand	None	Oxidation thick on core exterior. Coarse grained. Very loosely consolidated. Few medium mica flakes.

U894A 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
22 67.1' - 67.7'	2.5Y4/0 dark gray	Loamy sand - sandy loam	None	Oxidation thick on core exterior. No laminations. Very loosely consolidated. Mica flakes few to common, medium size.
	DEPTH BREAK 67.8' - 69.9'			
23 70.0' - 71.4'	2.4Y4/0 dark gray	Sandy loam - loamy sand	None	Oxidation on core exterior. Thin bedded mudstone in some places with faint laminations. Few to common medium to small mica flakes. Slightly more consolidated.
24 71.5 - 73.1'	2.5Y4/0 dark gray	Sandy loam - loamy sand	None	Oxidation on core exterior. Found few shale pieces. Loosely consolidated. Mica flakes common to many medium.
25 73.2 - 7417'	2.5Y4/0 dark gray	Sandy loam - loamy sand	None	Oxidation on core exterior. Loosely consolidated. Small pieces of carb evident. Few medium mica flakes.
26 74.9' - 76.3'	2.5Y3/0 sand mat'l 2.5Y2/0 black shale	Loam - loamy sand	None	Oxidation on core exterior. Shale with carb present. Consolidated somewhat. Thick bedding. Common to many medium size flakes of mica.

U894A 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
27 76.5' - 78.4'	2.5Y3/0	Loam - clay loam	None	Some oxidation on core exterior. Predominantly thin bedded shale. Some carb seen on beds.
28 78.5' - 80.4'	2.5Y3/0 with 2.5Y4/0	Loam - clay loam	None	Oxidation present on core exterior. Thin bedded shale surrounded by coarse grained partially oxidized material. Few to common medium to fine mica flakes.
29 80.5' - 81.7'	2.5Y3/0 2.5Y4/0 5YR4/8	Sandy loam to loam	None	Oxidation on core exterior. High moisture area. Some carb present. Somewhat consolidated. Thin bedded shale and mudstone in coarse grained matrix. Few fine flakes of mica.
30 82.0' - 83.7'	2.5Y3/0	Loam - clay loam	None	Oxidation on core exterior. Thick bedded shale and mudstone. Mica flakes deposited on laminations very heavily. Red oxidation present on faces.
	CAN #'s 31 AND 32 NOT PRESENT			
33 90.2' - 91.6'	2.5Y3/0	Loam - clay loam	None	Oxidation on core exterior. Sample consolidated and in round shape. Thick bedded shale. Red oxidation on laminae. Mica common to many medium flakes. Some carb present.
34 92.7 - 93.2'	2.5Y3/0	Loam - clay loam	None	.5' Foot total sample. Present in one piece with some coarse grained material in bag. Thick bedded mudstone and thin bedded shale. Mica common only on laminations - common medium flakes

U894A 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
35 93.6' - 95.5'	2.5Y4/0 2.5Y2/0	Loam to sandy loam	None	Oxidation on core exterior. Somewhat loosely consolidated mudstone-laminated. Some coarse grained loose sand material. Some fine carb present. Few medium to fine flakes of mica.
36 95.7' - 96.9'	2.5Y3/0	Loam to sandy loam	None	Somewhat loosely consolidated. Oxidation on core exterior. Thin bedded (some fissle) shale. Coarse grained material and many medium mica flakes present on laminae. Some red oxidation on laminae.
37 97.0' - 98.7'	2.5Y4/0	Loam - clay loam	None	Consolidated. Oxidation on core exterior, red oxidation on laminae plane. Some fissle shale and thin bedded shale. Mica common med. flakes on planes with coarse materials. Sample wet and muddy.
38 98.9' - 100.7'	2.5Y4/0	Loam - clay loam	None	Somewhat consolidated. Oxidation (thin) layer on core exterior. Thin bedded (some fissle) shale with thick bedded mudstone. Red oxidation present on laminae planes. Many medium mica flakes present on laminae and small carb pieces on laminae planes.
39 100.9' - 102.[illegible]'	2.5Y3/0	Loam - sandy clay loam	None	Oxidation on core exterior. Consolidated. Thick mudstone and thin bedded shale. Red oxidation on laminae planes. Mica flakes few to common on planes. Some carb present.

U694A 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
	DEPTH 102.8' - 107.1' MISSING			
40 107.2' - 109.1'	2.5Y4/0	Sandy loam	None	Oxidation on core exterior. Dominantly coarse grained, loosely consolidated material. Some small fragments of shale. Mica few medium flakes.
41 109.2' - 110.1'	2.5Y3/0	Sandy loam	None	Oxidation on core exterior. Thick bedded shale in coarse grained matrix. Predominantly coarse grained material. Most of sample oxidized except shale.
42 111.3' - 113.1'	2.5Y4/0	Sandy loam sand	None	Sample slightly consolidated. Oxidation on core exterior. 100% coarse grained material. Several larger pieces of carb. Few medium to fine flakes of mica.
43 113.3' - 115.2'	2.5Y4/0	Sandy loam - loamy sand	None	Sample slightly consolidated. Oxidation on core exterior. Some loosely consolidated and some fissle shale. Mica flakes are few medium. Predominantly coarse grained material.
	DEPTH 115.4' - 117.4' MISSING			
44 117.5' - 118.1'	2.5Y4/0	Sandy loam - loamy sand	None	Loosely consolidated. Oxidation on core exterior. Thin beds of shale with coarse material surrounding. Carb common medium chunks. Found small gray coarse fragment looked like chert. Appeared to be non-fossilized. Mica common small flakes.

TENNESSEE TOMBIGBEE WATERWAY

U895 44 CANS

7.6' ft. to 91.1'

General Notes: 1. All Samples Are Moist. 2. Colors Are Taken From Core Interior.

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
1 7.6' - 9.0'	2.5Y6/2	Fine sandy loam	None	Sample loosely consolidated. Red oxidation on core exterior is deep into core. Saturated with H_2O in places. Mottles are many and prominent. Weak subangular blocky structure. Few small flakes mica.
2 9.2' - 10.7'	2.5Y4/0	Clay loam - clay	None	Two large chunks in bag. No coarse fragments. Fine, heavy texture with high chroma mottling. Brown oxidation on core exterior. Few fine mica flakes.
	2.0' BREAK			
3 12.7' - 13.8'	2.5Y6/0 interior 2.5Y5/2 oxidation	Fine sandy clay loam	None	Brown oxidation on core exterior (thin). Sample looks like mud in bag. Consolidated and in one piece. Fine sand present. No coarse fragments. Very few small mica flakes. No mottling present.
4 16.2' - 18.0'	2.5Y5/0 interior 5Y5/2 oxidation	Sandy loam	None	Oxidation on core exterior in thin layer (note: color change). Loosely consolidated. Coarse grained sand. No coarse fragments. Mica flakes common medium.

U895 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
5 18.2' - 21.0'	2.5Y4/0	Sandy loam	None	Oxidation on core exterior. Loosely consolidated. Unfossilized but weathered pieces of plant and apparent crotovina (oxidized material). Mica flakes common to medium. Showing some structure: weak sub-angular blocky.
6 21.2' - 23.1'	2.5Y4/0	Sandy loam	None	Loosely consolidated. Structureless. Oxidation on core exterior. No coarse fragments. Mica few medium flakes.
7 23.3' - 25.2'	2.5Y4/0	Sandy loam	None	Consolidated (in several pieces). Small pieces of plant matter visible. Sample oxidized in some places on core exterior. Showing weak sub angular blocky structure also with some bedding of coarse material. Fine material showing bedding (Highly weathered shale?). Small pieces carb in fine material. NOTE: Plant matter is stem as seen under 30X scope.
8 25.4' - 27.4'	2.5Y4/0 interior 2.5Y5/4 light olive brown.			Sample is cylinder shape in bag. Thin layer of oxidation on core exterior. Oxidation is brown. (NOTE: color). Single grain structure. Some plant stems seen. Mica few small flakes.
9 27.5' - 29.4'	2.5Y4/0	Sandy loam	None	Oxidation on core exterior. Loosely consolidated. Thin bedded shale in places. Dominantly coarse grained, single grained material. Mica common medium flakes.

U895 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
10 29.7' - 31.6'	2.5Y4/0	Sandy loam	None	Loosely consolidated. Oxidation deep into interior in places. Mica common to many medium flakes. Mudstone present in fragment form.
11 31.9' - 33.1	2.5Y2/0	Loam	None	Thin layer of oxidation on core exterior. Thin bedded (some fissle) mudstone in sandy coarse grained matrix. Small pieces of carb on laminae. Mica common medium flakes.
12 34.1' - 35.3'	2.5Y4/0	Sandy loam - loamy sand	None	Oxidation - thin layer on core exterior. Consolidated. Thin bedded shale in some places. Mudstone fragments. Mica common medium flakes. Coarse grained material showing some bedding.
13 36.3' - 37.5'	2.5Y3/0	Loamy sand - loam	None	Thin layer of oxidation, 90% of core exterior. Predominantly thin bedded loosely consolidated shale with sand grains on laminae. Sample consolidated. After sand is washed away small pieces of carb are common. Mica prominent medium flakes.
14 38.0' - 39.9'	2.5Y3/0	Sandy loam	None	Thin layer of oxidation on core exterior. Slightly consolidated. Fissle single layered shale. Sandy material showing signs of bedding. Mica prominent medium flakes. Several large pieces of carb.

U895 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
15 40.1' - 42.0'	2.5Y3/0	Sandy loam	None	Oxidation on core exterior. Sample loosely consolidated. No shale or mudstone. No coarse fragments. Mica few to common fine to medium flakes. No bedding or laminations present.
16 42.1' - 43.9'	2.5Y5/0	Sandy loam	None	Sample loosely consolidated. Oxidation on core exterior is deep into core. Fine mudstone fragments are common. Mica flakes are common fine.
17 44.1' - 45.3'	2.5Y4/0	Sandy loam	None	Sample loosely consolidated. Oxidation on core exterior. Few medium flakes mica. Composed of loosely consolidated sand.
18 46.1' - 47.4'	2.5Y4/0	Sandy loam	None	Sample loosely consolidated. Oxidation on core exterior. No coarse fragments. Oxidation layer is thick. Common medium mica flakes.
19 48.2 - 49.9'	2.5Y4/0	Sandy loam	None	Oxidation on core exterior. Somewhat loosely consolidated. Faint signs of coarse grained bedding. Mica few medium to fine flakes.
20 50.1' - 51.85'	2.5Y5/0 2.5Y4/0	Sandy loam	None	Oxidation on core exterior. Loosely consolidated. Found long piece of plant material. Looks like corn silk. Dark and light color mixed. Mica common small flakes.

U895 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
21 52.1' - 53.7'	2.5Y4/0 5YR2.5/1 carb	Sandy loam	None	Loosely consolidated. Oxidation on core exterior. Several large pieces of carb visible in bag. Carb pieces are common. Mica common fine flakes.
22 54.1' - 55.9'	2.5Y5/0	Sandy loam - loamy	None	Oxidation on core exterior. Somewhat loosely consolidated. Thin beds of shale and mudstone. Mudstone fragments present. Carb pieces present in this fine grained material. Mudstone and shale fragments are common to many. Mica common small to medium flakes.
23 56.0' - 57.8'	5Y5/6 oxidation 2.5Y4/0 interior sand 2.5Y5 and 4/0 shale	Loam	None	Sample is one cylinder shaped piece in bag. Red and green oxidation on core exterior. Many carb fragments present. Whitish mudstone 10YR7/2 fragments are few. Some are soft, some harder and cannot be broken or crushed. Small carb fragment is these. Carb in sample is laminated with prominent medium flakes of mica on laminations (in one part of sample). Shale is fissle and thin bedded. Throughout sample coarse grained sandy material shows some bedding with high concentration of black nodules seen with 10X lens. At some parts, completely black out sample. Mica flakes are prominent medium on these laminations. Washed small part of sample and found small, possible fossilized pencil lead size fragments. Core was difficult to break open from original form.

[illegible] 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
24 58.0' - 59.4'	2.5Y5/0 2.5Y4/0	Sandy loam - loamy	None	Oxidation on core exterior. Core in one piece with very loosely consolidated material in bottom of bag. One layer of thin bedded shale in consolidated piece and one thick band of laminated carb. In this carb found hard, brittle dense layer with distinct pyrite deposits. Carb fragments large. Pyrite also found in sandy material. Mica flakes common medium.
25 59.75' - 61.5'	2.5Y4/0	Loam	None	Oxidation on core exterior. Somewhat consolidated. Very large piece of carb with other small fragments. Dominantly thin bedded shale with mudstone fragments. Mica flakes common to prominent medium. Small pieces of carb on shale laminae.
26 61.7' - 63.5'	2.5Y4/0	Loam - sandy loam	None	Oxidation on core exterior. Loosely consolidated with one consolidated large piece. Dominantly thin and thick bedded shale with few mudstone fragments. Hard brittle pyrite deposits found in sandy material. Mica flakes few medium. White mudstone found in bedded form as described in can 23 comments.
	CAN 27 MISSING 8/6/81 (Could be in other drum)			
27 63.7' - 64.2'				

U895 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
28 64.4' - 65.0'	2.5Y4/0	Sandy loam - loamy sand	None	Oxidation on core exterior. Loosely consolidated sample. Small mudstone fragments and small thin beds shale fragments heavily laden with black nodules seen with 10X lens. Mica flakes common medium.
29 65.2' - 66.4'	2.5Y4/2	Loam - loamy sand	None	Oxidation on core exterior. Loosely consolidated. Prominent small shale fragments. Carb fragments on laminae. Mudstone fragments common. White fragments are few (as described in can 23) 2.5Y7/2). Shale heavily laden with medium mica flakes and small black nodules. Mica medium few in sample.
30 66.9' - 68.7'	2.5Y4/0	Loam - loamy sand	None	Oxidation on core exterior. Loosely consolidated. Few small fragments of shale and mudstone. Shale has few to common carb fragments. Common small and medium mica flakes.
31 68.9' - 70.7'	2.5Y4/0	Sandy loam - loamy sand	None	Oxidation on core exterior. Somewhat loosely consolidated. Thick bedded 2.5Y6/2 shale present in large pieces. Small dark shale fragment present also. (Thin bedded). Light colored shale has common black nodules present. Mica flakes few medium.

U895 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
32 70.9 - 71.9'	2.5Y4/0	Sand - loamy sand	None	Somewhat consolidated. Oxidation on core exterior. Few single layer fissle shale beds. Mica few medium flakes.
33 72.1' - 74.1'	2.5Y3/0	Loam - sandy loam	None	Oxidation on core exterior. Sample loosely consolidated. Dominantly thick bedded mudstone. Mica flakes common medium.
34 74.3' - 76.1'	2.5Y4/0	Loamy sand - sandy loam	None	Slightly consolidated. Oxidation on core exterior. Thin bedded shale fragments common. White bedded material (can 23). Can be broken but not crushed with fingers. Small mica flakes are common. Found small chert-like gravel light colored 5Y6/2. Possibly water worn looks same as above only not bedded.
35 76.3' - 77.7'	2.5Y3/0	Loam - sandy loam	None	Oxidation on core exterior. Sample consists of one consolidated piece and a large amount of loosely consolidated material in bottom of bag. Predominantly thick bedded mudstone with some thin bedded shale. Red oxidation prominent on laminae. Mica common medium flakes.
36 77.9' - 79.7'	2.5Y6/0	Cherty sandy loam	None	Oxidation on core exterior. Sample is consolidated in one piece (large) and loosely consolidated material. Single piece is loamy sand material with a few chert fragments. (Hard chert, smooth material). Cannot be scratched. with knife blade. Black with touch of olive. Mica flakes common medium.

U895 44 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
37 79.9' - 81.3'	2.5Y5/0	Loamy sand - sandy loam	None	Loosely consolidated. Oxidation on core exterior. Thick bedded mudstone is common. Common small to medium mica flakes.
38 81.5' - 82.6'	2.5Y4/0	Loamy sand	None	Sample somewhat loosely consolidated. Oxidation on core exterior. Some loosely consolidated thin bedded shale. White material present - extremely firm. Mica flakes medium common.
39 82.8' - 83.9'	2.5Y4/0	Loamy sand	None	Oxidation on core exterior. Loosely consolidated. Some loosely consolidated mudstone (possibly weathered). Mica flakes few to common small.
40 84.1' - 84.7'	2.5Y4/0	Loamy sand	None	Loosely consolidated. Oxidation on core exterior. Thin bedded single layered shale (one bed). No other coarse fragments. Common medium mica flakes. Few large mica flakes.
	CANS 41 AND 42 MISSING 84.8' - 87.7'			
43 87.8' - 89.2'	2.5Y4/0	Sandy loam	None	Loosely consolidated. Oxidation on core exterior. Thick bedded shale with prominent mica flakes on laminations.
	CAN 44 MISSING 89.3' - 91.1'			

TENNESSEE TOMBIGBEE WATERWAY

U895A 13 CANS

5.0' ft. to 90.5'

General Notes: 1. All Samples Are Moist. 2. Colors Taken From Core Interior.

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
1 5.0' - 6.2'	2.5Y6/2 7.5YR5/0 mottles	Clay loam Fine sandy clay	None	No oxidation on core exterior. Sample is consolidated in one piece. Mottling is prominent and very many small pieces of stem are common. Few fragments of highly weathered shale or mudstone. Mica flakes very few fine.
	CAN NO. 2 12.0' - 13.9' MISSING			
3 19.0' - 20.4'	2.5Y4/0	Sandy loam	None	Sample consolidated into two large cylinder shaped pieces. Oxidation on core exterior. Sample wet (saturated). Mica flakes few medium. Few to common decayed but unfossilized plant tissue.
4 26.0' - 27.8'	2.5Y5/0	Loamy sand - sandy loam	None	Oxidation on core exterior. Small coarse fragments common. Possible water worn gravel or chert: black, red and white. Small roots (fibrous) are common. Few decayed but not fossilized plant material. Pungent smell. Samples show weak subangular blocky structure.

U895A 13 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
5 33.0' - 34.7'	2.5Y3/0	Sandy loam - loam	None	Oxidation on core exterior. Loosely consolidated. Many small shale (thin bed) fragments. Many small carb fragments seen when sample washed. Not seen in sample. Common medium mica flakes.
	CAN NO 6 40.0' - 41.7' MISSING			
7 47.0' - 48.8'	2.5Y4/0	Loamy sand	None	Oxidation on core exterior. Somewhat consolidated. Single thin layered shale. No coarse fragments. Mica common medium flakes.
8 54.0' - 55.8'	2.5Y4/0	Loamy sand	None	Oxidation on core exterior. Somewhat consolidated. Single thin layered shale common. Medium size carb fragments common. Mica flakes medium common.
9 61.1' - 62.8'	2.5Y6/0	Loamy sand	None	Oxidation on core exterior. Thin bedded shale few. Few mudstone fragments. One area had laminated carb loosely consolidated. Small carb fragments common in sample. Mica flakes medium common.
10 68.0' - 69.0'	2.5Y4/0	Sandy loam	None	Oxidation on core exterior. Common medium bedded shale. Few mudstone fragments. Many medium mica flakes on laminae, common medium in sample.

U695A 13 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
11 75.0' - 75.8'	2.5Y3/-	Loam - clay loam	None	Oxidation on core exterior. 100% thin to medium bedded (some fissle) consolidated shale. Mica on laminae common to few medium.
12 82.0' - 83.6'	2.5Y4/0	Loamy sand	None	Oxidation layer thick on core exterior. Few single layered shale, thin bedded. Loosely consolidated. Few small carb fragments seen only after washing sample. Mica few medium flakes.
13 89.0' - 90.5'	2.5Y5/0	Loamy sand	None	Oxidation on core exterior. Loosely consolidated. Very few small thin bedded shale fragments. Common medium flakes, few large flakes of mica. Few carb fragments.

TENNESSEE TOMBIGBEE WATERWAY

U896 45 CANS

3.4' ft. to 94.1'

General Notes: 1. All Samples Are Moist. 2. Colors Taken From Core Interior.

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
1 3.4' - 5.3'	10YR5/2	Fine sandy clay	None	Sample sightly consolidated. Prominent mottles are common. Moderate sub-angular blocky structure. Large roots and plant material visible. Small carb fragments present.
	CAN NO 2 5.4' - 7.3' MISSING			
3 7.4' - 9/3'	2.5Y7/2	Clay loam	None	Sample consolidated. Mottles prominent and common. Root activity visible as well as buried plant material (decayed) that serves as passage for roots. Fossilized roots, carb. Carb present in small fragments.
4 9.4' - 10.7'	2.5Y5/2	Clay loam	None	Sample consolidated. Mottles prominent and common. Small gravel common when sample washed. Some fine roots. Some carb present in small fragments.

U896 -5 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
5 11.4' - 13.1'	5Y5/0	Sandy clay loam	None	Sample consolidated in one piece and some loosely consolidated material. Loosely consolidated material appears to have 5Y6/1 exterior and 7.5Y5/6 and 8 interior. Gray material is fine textured and saturated on outside, coarse textured and dry in interior, carb pieces nickle and quarter size; fissle, laminated with bright orange lamination, few large mica flakes.
6 13.4' - 14.8'	2.5Y5/0	Loamy sand - sandy loam	None	Sample loosely consolidated. Oxidation on core exterior. Many large wood fragments. Some rotten, some turned partway to carb. Very few medium mica flakes.
7 15.2' - 16.8'	5Y5/1	Loamy sand	None	Sample consolidated in one piece with some loosely consolidated material in bag. Oxidation on core exterior. Many wood fragments present in whole pieces and layered. Few medium mica flakes.
8 17.2' - 19.1'	5Y5/2	See Note	None	Sample consolidated in several cylinder shape pieces. One cylinder shaped piece is solid wood. Another solid wood piece present. Black on exterior, orange in middle. One consolidated piece is coarse textured material with many wood fragments. Two textures present: Loamy sand and sandy clay. Few medium mica flakes.

U896 45 CANS (continued)

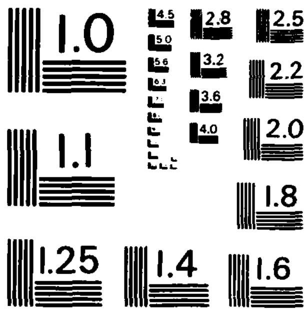
Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
9 19.2' - 21.0'	5Y5/2	Loamy sand	None	Sample somewhat consolidated. Oxidation on core exterior. Fine textured material on outside is wet and elastic. Coarse grained material on interior dry. Common wood fragments. Found 1/2 of hickory nut. Some wood is layered and partially carbed. Few medium mica flakes.
10 21.3' - 23.2'	5Y5/1	Sandy loam	None	Two consolidated pieces and some loosely consolidated material. Oxidation on core exterior. Completely consolidated coarse material showing weak sub-angular blocky structure. Small fine pieces of plant material visible. Few medium to large mica flakes.
11 23.4' - 25.0'	5Y5/1	Sandy loam	None	Sample is consolidated. Oxidation on core exterior. Few very small pieces of plant material. Sample shows weak sub-angular blocky structure. Pockets of fine textured material around plant matter. Few medium size mica flakes.
12 24.4' - 27.1'	5Y5/1	Loamy sand	None	Sample somewhat consolidated. Scattered few pieces of plant material. Few small mica flakes. Oxidated on core exterior.
13 28.4' - 29.3'	5Y5/1	Loamy sand	None	Sample loosely consolidated. Many plant material fragments. Few small mica flakes.

U896 45 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
14 29.5' - 31.3'	Not on 5Y Page; greener	Loamy sand	None	Can 14 is split in two bags. One marked Eutaw, one marked Alluvium. The alluvium can is somewhat consolidated. Oxidation on core exterior. Few to common medium mica flakes.
14 29.5' - 31.3' Eutaw	2.5Y4/0	Loamy sand	None	Oxidation on core exterior. Sample loosely consolidated. Some fragments of bedded mudstone. Light color mica flakes. Very many large to medium mica flakes.
15 31.5' - 32.0'	2.5Y6/0	Loamy sand	None	Sample loosely consolidated. Red oxidation on core exterior. Very few small fragments of white, light colored mudstone. Mica flakes common medium to large.
16 32.2' - 32.8'	2.5Y5/0	Sandy loam	None	Oxidation on core exterior. Very small sample (note depth). Loosely consolidated. Few small carb fragments. Common medium, few large mica flakes.
17 33.0' - 34.7'	2.5Y5/0	Loamy sand	None	Oxidation on core exterior. Loosely consolidated. Few fragments of white mudstone. Mica flakes many medium to large.

AD-A132 615 SOIL AND VEGETATION PROJECT A DETAILED STUDY OF FIVE OVERBURDEN CORES AND..(U) TENNESSEE TECHNOLOGICAL UNIV COOKEVILLE DEPT OF PLANT AND SOI.. J T AMMONS ET AL. 17 JUN 83 DACW62-81-C-0205 4/5

UNCLASSIFIED F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

U896 45 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
18 34.9' - 36.4'	2.5Y5/0	Loamy sand	None	Sample somewhat consolidated. Oxidation on core exterior. Sandy material showing some bedding with one thin bed of light colored mudstone. Mica flakes common medium, few large.
19 36.6' - 38.5'	2.5Y5/0	Loamy sand	None	Oxidation on core exterior. One consolidated piece with a lot of loosely consolidated material showing bedding of sandy material. Many medium mica flakes. Few fragments of mudstone. Black nodules in high concentration in spots.
20 38.7' - 40.6'	2.5Y5/0	Loamy sand	None	Oxidation on core exterior. Sample somewhat consolidated. Thin bed of sandy material. Mica flakes many medium to large in bedded sandy material. Mica flakes lie horizontal to bedded planes.
21 40.8' - 42.7'	2.5Y5/0	Sandy loam	None	Note on can says "green material contaminated with drilling mud". Sample loosely consolidated. Oxidation on core exterior with dark olive green material (greener than 5Y Hue). Many mica flakes medium to large.
22 43.4' - 44.7'	2.5Y5/0	Loamy sand	None	Sample loosely consolidated. Oxidation on core exterior. Consolidated piece showing distinct thin beds of sandy material. Few small fragments of light colored mudstone. Mica flakes common to many, medium to large.

U896 45 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
23 44.9' - 46.8'	2.5Y5/0	Loamy sand	None	Sample somewhat consolidated. Oxidation on core exterior. One consolidated piece shows thin bedding of sandy material with one thin bed of light colored mudstone. Mica flakes many medium.
24 47.0' - 48.9'	2.5Y5/0	Loamy sand	None	Sample somewhat consolidated. Thick oxidation layer on core exterior. Mica flakes common medium to large.
25 49.1' - 51.0'	2.5Y4/0	Loamy sand	None	Oxidation on core exterior. One small speck of carb found. Sample somewhat consolidated. Mica flakes common medium to large.
26 51.0' - 53.1'	2.5Y5/0	Loamy sand	None	Sample loosely consolidated. Oxidation on core exterior. Small fragments of light colored mudstone are common. Common mica flakes medium to large.
27 53.5' - 55.2'	2.5Y3/0 2.5Y4/0	Sandy loam	None	Sample somewhat consolidated. Oxidation on core exterior. One consolidated piece shows layered mudstone in several places. Mudstone 2.5Y3/0 with 2.5Y2/0 carb fragments scattered commonly on mudstone laminae. Some thin-bedded loosely consolidated shale. Mica flakes very many medium to large.

U896 45 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
28 55.4' - 57.0'	2.5Y4/0 2.5Y3/0	Sandy loam	None	Sample loosely consolidated. Oxidation on core exterior. Thick and thin bedded mudstone 2.5Y3/0 in a sandy 2.5Y4/0 matrix. Mica flakes common medium.
29 57.2' - 59.1'	2.5Y4 and 3 / 0	Sandy loam - sandy clay loam	None	Sample loosely consolidated. Oxidation on core exterior. Thin bedded mudstone 2.5Y3/0 in a sandy matrix 2.5Y4/0. Mica flakes many medium to fine on laminae.
	NOTE DEPTH BREAK			
30 61.4' - 63.3'	2.5Y5/0 2.5Y6/2	Sandy loam	None	Sample in one piece. Oxidation on core ex-exterior. Shows sandy material with one thick bed of light colored mudstone. Carb fragments (very small) scattered throughout mudstone sample. One water worn chert-like rock found (dark black). Mica flakes few to common medium.
31 63.5' - 65.4'	2.5Y4/0	Sandy clay loam	None	Sample loosely consolidated. Oxidation on core exterior. Large pieces of thick bedded mudstone with carb pieces on laminae. Thin bedded shale with high mica concentrations on laminae.

C89b -5 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
32 65.6' - 67.5'	2.5Y5/0	Loamy sand Sand	None	Sample loosely consolidated. Oxidation deep into core. Mica flakes common medium. 100% sandy material.
33 67.8' - 69.7'	2.5Y5/0	Loamy sand	None	Sample loosely consolidated. Oxidation on core exterior is thick. Mica flakes common medium to large. 100% sandy material "Disturbed" - See Core Log.
34 70.2' - 71.9'	2.5Y4/0	Sandy loam	None	Sample somewhat consolidated. Oxidation on core exterior. Thin bedded, some fissle shale with mudstone fragments. Carb common in small pieces. Medium mica flakes almost completely cover some laminae surfaces. Very many medium flakes in sample. **When fizz test taken, smelled like rotten eggs.
35 72.1' - 73.8'	2.5Y4/0	Sandy loam	None	Sample loosely consolidated. Oxidation on core exterior. Mudstone fragments medium size with sandy material. Found one rock (apparently not water worn) could not scratch with knife. No fizz. Mica flakes common medium.
36 74.0' - 75.3'	2.5Y4/0	Loamy sand	None	Loosely consolidated. Oxidation on core exterior. Few small mudstone fragments. One large piece of carb. Mica flakes common medium.

U896 45 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
37 75.5' - 77.4'	2.5Y5/0	Sandy loam	None	Sample somewhat consolidated. Oxidation on core exterior. One consolidated piece contains one layer of thick bedded mudstone, carb fragments (small) and medium mica flakes on laminae. Common medium flakes in sample.
38 77.6' - 79.5'	2.5Y4/0	Sandy loam	None	Sample somewhat loosely consolidated. Oxidation on core exterior. One consolidated piece had one layer of white mudstone. Had to break open with hammer. White mudstone common in sample but softer. Common medium, few large mica flakes.
39 79.7' - 81.6'	2.5Y4/0	Loamy sand	None	Loosely consolidated. Oxidation on core exterior. Few light colored fragments and beds of mudstone. Small carb fragments common in mudstone. Mica flakes common medium.
40 81.9' - 83.7'	2.5Y3/0	Sandy loam	None	Somewhat consolidated. Oxidation on core exterior. Thin bedded mudstone, many layers in sandy matrix. Mica flakes many medium to large.
41 83.9' - 85.8'	2.5Y4/0	Sandy loam	None	Loosely consolidated. Oxidation on core exterior. Few thin beds of shale. Carb fragments and mica on laminae planes. Mica flakes many medium.

U896 45 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
42 81.0' - 82.9'	2.5Y4/0	Sandy loam	None	Somewhat consolidated. One consolidated piece shows many thin beds of mudstone in a sandy matrix. Mica flakes common fine to medium. Hole in bag.
43 88.1' - 89.7'	2.5Y3/0	Sandy loam	None	Somewhat consolidated. Oxidation on core exterior. Many thin beds of mudstone with small carb fragments on laminae planes. Mica flakes common medium.
44 89.9' - 91.8'	2.5Y4/0	Loamy sand	None	Loosely consolidated. Oxidation on core exterior. Few very small mudstone fragments. Mica flakes many medium to large.
	CAN 45 MISSING			

TENNESSEE TOMBIGBEE WATERWAY

U897 57 CANS

5.0' ft. to 91.8'

General Notes: 1. All Samples Are Moist. 2. Colors Taken From Core Interior.

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
1 5.0' - 6.4'	7.5YR 5/8 top 2.5Y 6/2 bottom	Sandy loam	None	One consolidated piece. Note color differences from top to bottom. Few scattered paint fragments. Mica flakes few to common medium. Showing single grained structure.
2 7.0' - 8.8'	5Y5/3 bottom 10YR5/6 top	Sandy loam	None	Sample consolidated in one piece. Very few small carb fragments. Sample soggy. Mica flakes very few medium. Single grain structure.
3 9.0' - 10.8'	5Y6/1	Loamy sand - sand	None	Sample somewhat consolidated. 100% loosely consolidated sand. Faint layer of oxidation (faint color difference). Mica few fine flakes.
4 11.9' - 12.8'	2.5Y7/2 oxidation 5Y5/1	Loamy sand - sand	None	Sample somewhat consolidated. Oxidation on core exterior. Mica flakes few to common. Few scattered decomposed plant fragments.
5 13.0' - 14.8'	5Y6/1	Loamy sand-sand	None	Sample somewhat consolidated. Oxidation on core exterior. Mica flakes few fine.

:897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
6 15.0' - 16.6'	2.5Y5/0	Loamy sand	None	Sample loosely consolidated. Oxidation on core exterior is thin. Mica few flakes. 100% loosely consolidated sand. Less moisture than above samples.
7 16.9' - 18.8'	2.5Y5/0	Loamy sand - sand	None	Sample somewhat consolidated. Oxidation on core exterior. No coarse fragments of any kind present. Mica flakes very few fine.
8 19.0' - 20.8'	5Y5/1	Sandy loam	None	Sample somewhat consolidated. Oxidation on core exterior. 100% sandy material. Mica flakes few medium to fine.
9 20.1' - 22.8'	5Y5/1	Sandy loam	None	Sample loosely consolidated. Oxidation on core exterior. 100% sandy material. Mica flakes few fine.
10 23.0 - 24.2'	2.5Y4/0	Sandy loam - loamy sand	None	Sample loosely consolidated. Oxidation on core exterior. Few scattered mudstone fragments. Mica flakes few medium.
11 24.4' - 25.7^2	2.5Y4/0	Sandy clay - loam	None	Sample loosely consolidated. Oxidation on core exterior. Many carb fragments present. Many mudstone fragments (small). Mica flakes common fine.

U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
12 25.9' - 27.5'	2.5Y4/0	Loam	None	Very large sample. Loosely consolidated. Oxidation on core exterior. May thin bedded shale fragments. Some carb. Common medium mica flakes.
13 27.7' - 28.8'	2.5Y3/0	Sandy loam	None	Oxidation on core exterior. Several medium size carb fragments. Mica medium common flakes. Loosely consolidated. Scattered (several) mudstone fragments.
14 29.0' - 31.1'	2.5Y3/0	Sandy loam	None	Loosely consolidated. Oxidation on core exterior. Common to many medium mica flakes. Many small carb fragments.
15 30.3' - 31.8'	2.5Y3/0	Fine sandy loam	None	Loosely consolidated. Oxidation on core exterior. Showing layering of black specks. No coarse fragments. Mica flakes common medium. See core log for note.
16 32.0' - 33.1'	2.5Y4/0	Fine sandy loam	None	Somewhat consolidated. Oxidation on core exterior. Bedding of black specks. Very thin carb layers in places. Coarse fragments. Common medium mica flakes.
17 33.3' - 34.4'	2.5Y3/0	Sandy loam	None	Loosely consolidated. Oxidation on core exterior. Slight bedding of material shown. Mica flakes common to many medium.

U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
18 34.6' - 35.7'	2.5Y4/0	Sandy loam	None	Somewhat consolidated. Oxidation on core exterior. Red oxidation on interior side of weathering rind. Thin bedding of material present. No coarse fragments. Mica flakes common fine.
19 35.9' - 36.9'	2.5Y4/0	Sandy loam	None	Loosely consolidated. Oxidation throughout can. Mica flakes medium common. 100% sandy material.
20 37.1' - 38.6'	2.5Y3/0	Sandy loam	None	Material showing bedding. Somewhat consolidated. Oxidation on core exterior with red oxidation moving into interior. A few sizeable pieces of carb. Mica flakes medium fine common.
21 38.8' - 40.65'	2.5Y3/0	Sandy loam	None	Oxidation on core exterior. One consolidated piece with unconsolidated material. Bedded (thin) sandy material with thin layered carb. Mica flakes common medium.
22 40.8' - 42.65'	2.5Y4/0	----	None	Somewhat consolidated. Oxidation on core exterior and unconsolidated material completely oxidized. Thin layered soft carb throughout sample. Mica flakes fine common.

U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
23 42.8' - 44.0'	2.5Y4/0	Fine sandy loam	None	Somewhat consolidated. Oxidation on core exterior and all unconsolidated material. Fine bedded sandy material with carb layers and chunks. Found pyrite in one carb chunk. Mica flakes common medium.
24 44.2' - 45.8'	2.5Y3/0 and 2.5Y4/0	Sandy loam	None	Somewhat consolidated. Oxidation on core exterior. Thin bedded sandy material with one layer of mudstone. Common medium mica flakes.
25 46.0' - 47.1'	2.5Y3/0 and 2.5Y4/0	Fine sandy loam	None	Loosely consolidated. Oxidation on all core material. Thin bedded sandy material. Mica flakes common medium.
26 47.3' - 48.3'	Oxidized	Fine sandy loam	None	Can oxidized throughout. Loosely consolidated sandy material. Common medium mica flakes.
27 48.5' - 49.4'	2.5Y3/0 2.5Y2/0	Fine sandy loam	None	Consolidated in one piece. Oxidation throughout most of can. Shows thin bedding of sandy material. Quite stiff but no mudstone. Many fine and medium mica flakes.
28 46.6' - 50.2'	2.5Y2/0 and 2.5Y3/0	Fine sandy loam	None	Consolidated in one piece. Oxidation throughout most of can. Shows thin bedding. Stiff sandy material. Many fine and medium mica flakes.

U897 57 CANS (continued)

Car. No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
29 50.4' - 51.0'	2.5Y3/0	Fine sandy loam	None	Can loosely consolidated. Oxidized throughout. Stiff thin bedded sandy material with paper-thin mudstone beds. Mica flakes common medium.
30 51.2' - 52.5'	2.5Y3/0 and 2.5Y4/0	Sandy loam	None	Can is consolidated in layers. Oxidation on core exterior. Very prominent thin beds of sandy material throughout. Mica flakes common medium.
31 52.7' - 53.8'	2.5Y2/0	Sandy loam oxidized material	None	Can consists of oxidized material (bedded). Around 2.5Y2/0. Stiff somewhat bedded (shows signs of) material. Alternate colors not seen. Very many medium mica flakes.
32 54.0' - 55.0'	See comm.	Sandy loam	None	Oxidized on can exterior. Shows thin bedding of sandy material with 2.5Y2/0 & 3/0 & 4/0 alternating colors. Many medium mica flakes.
33 55.2' - 56.2'	2.5Y4/0 and 2.5Y5/0	Sandy loam	None	Can unconsolidated. Oxidized throughout. Showing lighter colored thicker beds of material. One piece of mudstone. Found mica flakes congregated at darker (2/0) color areas, common medium.
34 56.4' - 57.5'	----	Sandy loam	None	Very small, thoroughly oxidized sample. Loosely consolidated. Some mudstone fragments. Few medium, common mica flakes.

U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
35 57.7' - 58.8'	2.5Y4/0	Sandy loam	None	Can loosely consolidated. Material oxidized with one consolidated piece oxidized on exterior. Shows thin bedded 2.5Y4/0 with one layer of 2.5Y2/0 stiff material. Mica flakes many large in 2/0 material. Common medium elsewhere.
36 59.0' - 60.7'	2.5Y2/0	Mudstone clay loam	None	Can somewhat consolidated. Oxidation on core exterior. Larger fragments are bedded mudstone - Fissle to thick. On beds much moisture present. One light colored mudstone fragment. Had to break with hammer. Mica flakes present only in unconsolidated material, few medium flakes. Found shark's teeth pieces during sample preparation.
37 60.9' - 62.2'	----	Sandy loam	None	Can unconsolidated. Oxidized throughout. Many mudstone fragments thin bedded. 2.5Y3/0 and 2.5Y6/2 mudstone. Few common fine mica flakes.
38 62.4' - 63.9'	----	Sandy loam	None	Can somewhat consolidated. Shows 2.5Y3/0 thin bedded sandy material with one thick bed of mudstone. Mica flakes common to fine. One area of 2.5Y3/0 and 6/0 sand found.

U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
39 64.6' - 65.5'	2.5Y4/0	Sandy loam	None	Can loosely consolidated. Oxidized throughout. Composed of loosely consolidated sandy material. Few mudstone fragments. 2.5Y4/0 mica flakes few to common medium.
40 65.7' - 67.2'	----	Sandy clay loam	None	Can loosely consolidated. Fully oxidized. Sandy material with large mudstone fragments. 5Y6/2 and 2.5Y4/0. Thin bedded mudstone with carbon on laminae. Larger fragments have conchoidal fractures and are light colored stiff thick single bedded. Found one large rock - very hard washed, broke with hammer. Large pyrite deposit. Mica flakes few to common fine. Few medium. Found whole shark's tooth during sample preparation.
41 67.7' - 69.5'	----	Sandy clay loam	None	Can somewhat consolidated. Oxidation throughout. Fissle 2.5Y4/0 shale - very soft. Found one flat rock "creek" rock. Barely broke with hammer. 2.5Y6/2. One consol. piece shows decomposed silty mudstone (2.5Y3/0) with bedded mudstone. Mica flakes - fine common to many.
42 69.7' - 70.7'	2.5Y4/0	Sandy loam	None	Core loosely consolidated. Oxidized throughout. 100% sandy material. Mica flakes few to common medium.

U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
39 64.6' - 65.5'	2.5Y4/0	Sandy loam	None	Can loosely consolidated. Oxidized throughout. Composed of loosely consolidated sandy material Few mudstone fragments. Mica flakes few to common medium.
40 65.7' - 67.2'	----	Sandy clay loam	None	Can loosely consolidated. Fully oxidized. Sandy material with large mudstone fragments. 5Y6/2 and 2.5Y4/0. Thin bedded mudstone with carbon on laminae. Larger fragments have conchoidal fractures and are light colored stiff thick single bedded. Found on large rock - very hard washed, broke with hammer. Large pyrite deposit. Mica flakes few to common fine. Few medium. Found whole shark's took during sample preparation.
41 67.7' - 69.5'	----	Sandy clay loam	None	Can somewhat consolidated. Oxidation throughout. Fissle 2.5Y4/0 shale - very soft. Found one flat round "creek" rock. Barely broke with hammer. 2.5Y6/2. One consol. piece shows decomposed silty mudstone (2.5Y3/0) with bedded mudstone. Mica flakes - fine common to many.
42 69.7' - 70.7'	2.5Y4/0	Sandy loam	None	Core loosely consolidated. Oxidized throughout. 100% sandy material. Mica flakes few to common medium.

U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
43 70.9' - 72.0'	2.5Y4/0	Sandy loam	None	Loosely consolidated. Oxidized sandy material. Common medium mica flakes.
44 72.2' - 73.1'	2.5Y5/0	Sandy loam	None	100% loosely consolidated oxidized material. Common medium mica flakes.
45 73.3' - 74.5'	2.5Y3/0	Sandy loam	None	Can consolidated. Oxidized on core exterior. Shows thin bedded mudstone with sandy material. One piece of 2.5Y7/2 mudstone. Mica flakes common fine.
46 74.7' - 75.5'	----	Sandy loam	None	One consolidated piece with much loose material. Oxidation on exterior. 2.5Y4/0 sandy material with thin beds of mudstone. Many dry sandy stiff areas 5Y6/2. Mudstones single bedded. Mica flakes common fine to medium.
47 75.7' - 77.0'	2.5Y4/0	Sandy loam	None	Can loosely consolidated. Oxidized throughout. Many medium mica flakes.
48 77.2' - 78.3'	2.5Y4/0	Sandy loam	None	Can loosely consolidated. Oxidized throughout. Few mudstone fragments. Single bed. Mica flakes common to many medium.
49 78.5' - 79.5'	----	Sandy loam	None	Can unconsolidated sandy material. Thoroughly oxidized throughout. Mica flakes common to many medium.

U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
50 79.3' - 80.1'		Sandy loam	None	Can loosely consolidated. Completed oxidized. Mica flakes many medium.
51 80.3' - 81.9'	2.5Y3/0 5Y3/2 wet	Clay	None	SEE NOTE IN LOG. Never have seen this before. Thin bedded mudstone. No sand present. Very many very fine mica flakes on laminae.
52 82.3' - 83.8'	2.5Y5/0	Sand	None	Oxidation on core exterior but not green like before. Sandy material (coarse - v. coarse) with many water worn rocks of all sizes. Very tiny to larger. Sample very wet. No mica flakes.
53 84.0' - 85.7'	2.5Y4/0	Loamy sand	None	Can loosely consolidated. Oxidized on can exterior. Coarse sandy material with very many small water worn rocks. Many medium mica flakes.
54 85.9' - 86.9'	2.5Y3/0	Sandy loam - sandy clay loam	None	Can loosely consolidated. Oxidized on exterior. Dark sandy material with very thin mudstone beds. Many fine and medium mica flakes.

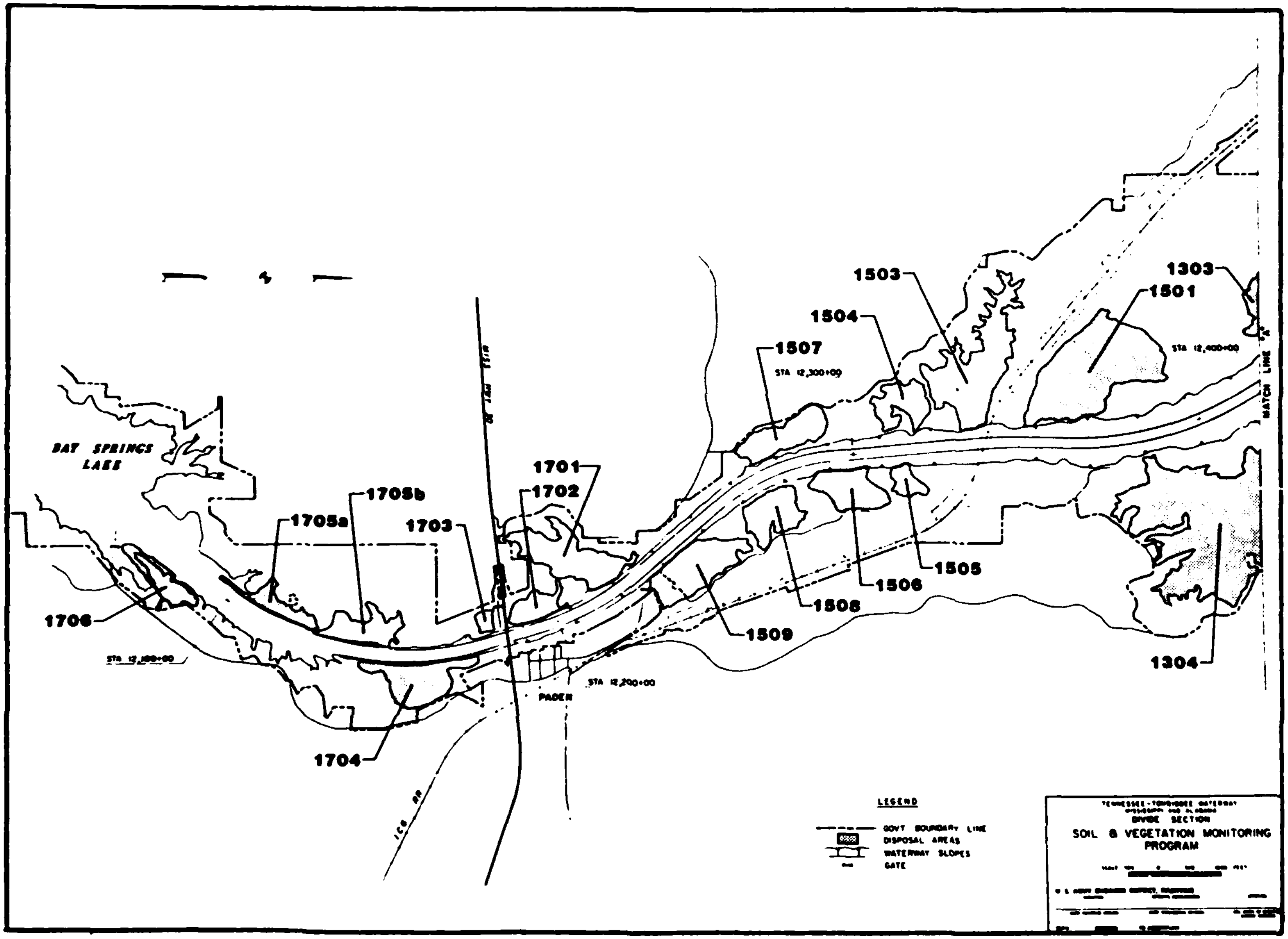
U897 57 CANS (continued)

Can No. & Depth (feet)	Bulk Sample Color	Texture	Fizz	Characteristics and Comments
55 87.1' - 88.6'	2.5Y6/0	Sandy loam	None	Can loosely consolidated. Oxidized throughout. Few thin beds of mudstone with light colored sand. Not as coarse as has been. Many fine mica flakes.
56 88.8' - 89.4'	2.5Y5/0	Sandy loam	None	Can loosely consolidated. Oxidized throughout. Many fine mica flakes.
57 89.6' - 91.8'	2.5Y4/0	Sandy loam	None	Can loosely consolidated. Oxidized on exterior. Very few beds of thin mudstone. Very many fine mica flakes.

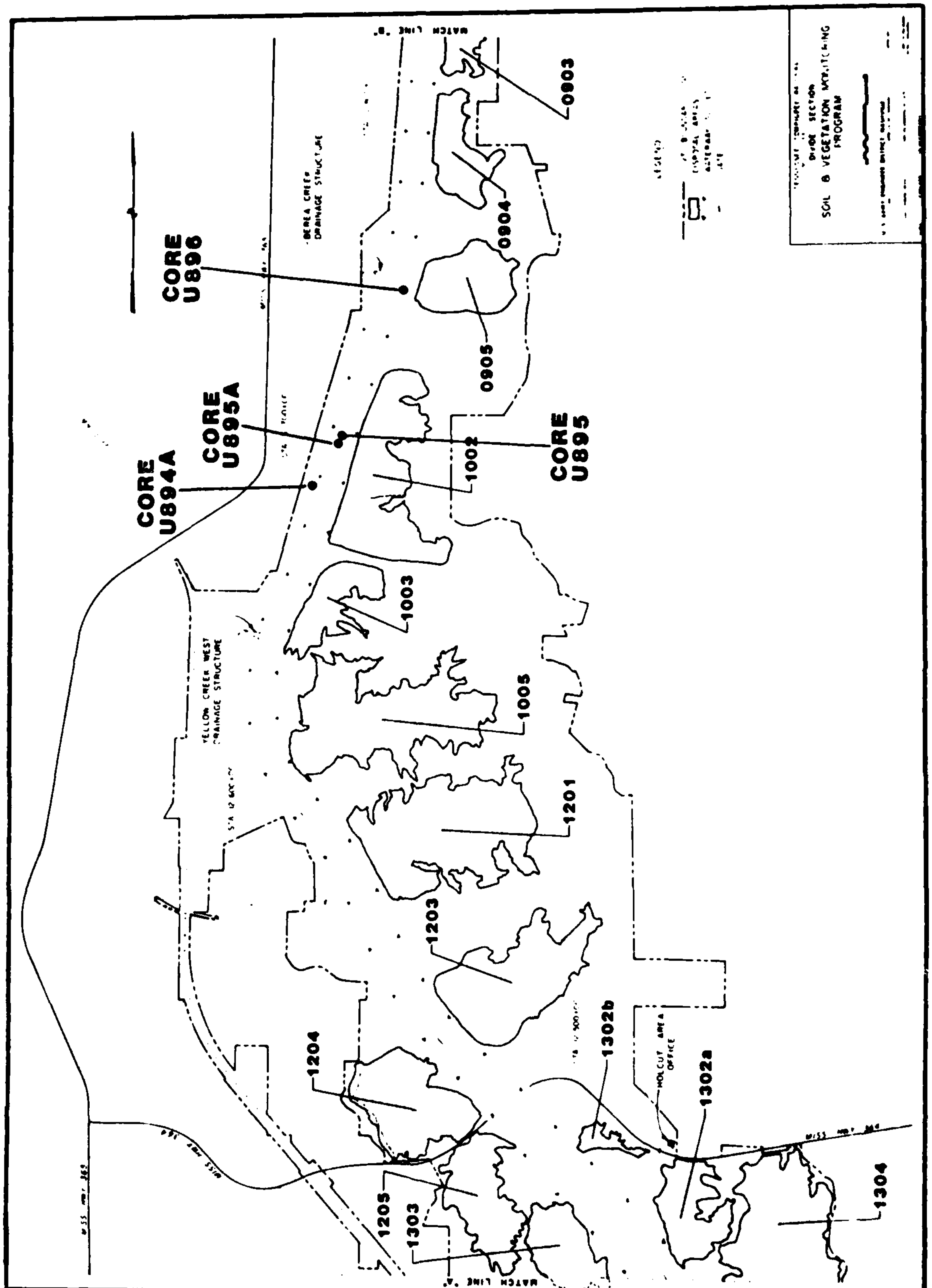
A P P E N D I X B

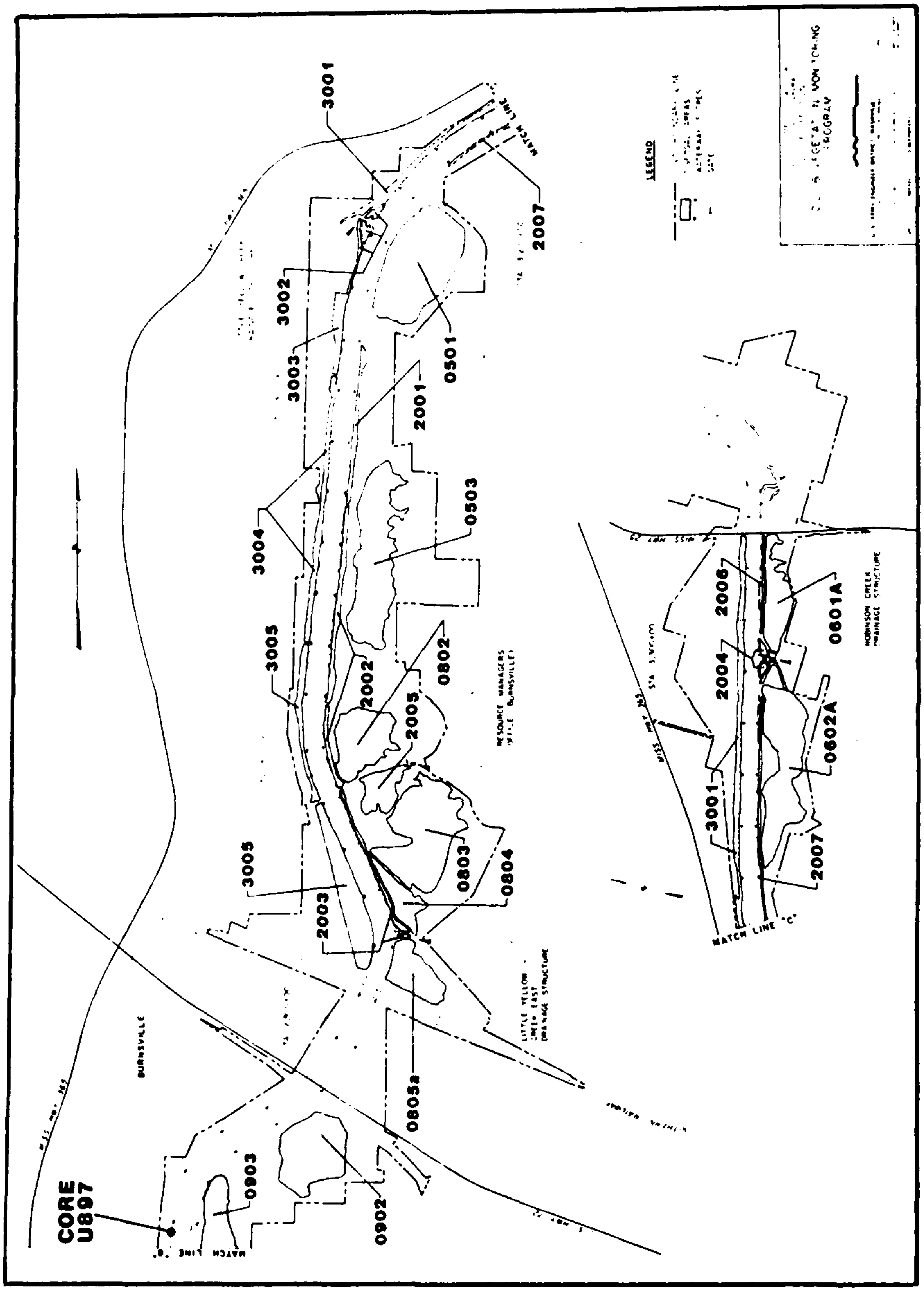
Disposal Area and Core Locations

Divide Section - Tennessee Tombigbee Waterway



1303
1501
1503
1504
1507
STA 12,400+00
STA 12,300+00
MATCH LINE
BAY SPRINGS LAKE
1701
1702
1703
1705a
1705b
1706
STA 12,100+00
MISS HWY 30
1505
1506
1508
1509
1304
PADEN
STA 12,200+00
1704
ICG RR
LEGEND
GOVT BOUNDARY LINE
DISPOSAL AREAS
WATERWAY SLOPES
GATE
DIVIDE SECTION
SOIL & VEGETATION MONITORING PROGRAM


CORE
U896
CORE
U895A
CORE
U894A
CORE
U895
0903
0904
0905
1002
1003
1005
1201
1203
1204
1205
1303
1302b
1302a
1304
YELLOW CREEK WEST
DRAINAGE STRUCTURE
HOLCUT AREA
OFFICE
SOIL & VEGETATION MONITORING
PROGRAM


CORE U897
0903
0902
0805a
BURNSVILLE
LITTLE YELLOW CREEK EAST DRAINAGE STRUCTURE
2003
3005
0803
0804
2005
2002
0802
RESOURCE MANAGERS OFFICE BURNSVILLE
3005
3004
0503
2001
3003
3002
0501
3001
2007
LEGEND
2006
0601A
ROBINSON CREEK DRAINAGE STRUCTURE
2004
0602A
3001
2007
MATCH LINE "C"

APPENDIX C

Evaluation of Lime Distribution on Demonstration Plots

Disposal Area 1504

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Dr. Smith and Dr. Ammons, Plot Area 1504 - Check for free carbonates from 0-13". Samples will be done as vegetated and bare: 2 vegetated, 2 bare in each plot.
Check was completed to evaluate incorporation of lime due to "spotty" or streaked vegetation.

REP I - LR 5

1. Vegetated - carbonate extensive present to 0-6". Concentrated. No low chroma nodules on surface.

2. Non-vegetated - free carbonates at 12". None above. Low chroma nodules present on surface.

3. Vegetated - free carbonates at 0-1". Low chroma nodules present on the surface.

4. Non-vegetated - 0-7", no free carbonates. 7-12" free carbonates.

REP I - LR 3

1. Non-vegetated - 0-13" no free carbonates. Low chroma nodules on surface.

2. Vegetated - 0-8" free carbonates, 8-13" no free carbonates.

3. Non-vegetated - 0-5" no free carbonates, 5-9" free carbonates, 9-13" none.

4. Vegetated - 0-5" free carbonates, 5-13" none.

REP I - LR 1

1. Non-vegetated - 0-13" no free carbonates.

2. Vegetated (slightly) - 0-4" free carbonates, 4-13" none.

3. Vegetated - 0-1" free carbonates, 1-13" none (green low chroma).

4. Non-vegetated - 0-13" none, low chroma nodules on surface.

REP I - LR 2

1. Non-vegetated - 0-13" no free carbonates, low chroma on surface.

2. Vegetated - 0-1" free carbonates, 1-2" none, 3-4" free carbonates - no free carbonates on the rest.

3. Non-vegetated - 0-13" no free carbonates.

4. Vegetated - 0-1" free carbonates, 1-13" none.

REP I - LR 4

1. Vegetated - 0-7" free carbonates, 7-13" none.

2. Vegetated - 0-6" free carbonates, 6-13" none.

3. Non-vegetated - 0-6" none, 6-9" free carbonates, 9-13" none - L.C. material on surface.

4. Non-vegetated - 0-7" none, 7-9" free carbonates - 9-13" none - L.C. material on surface.

REP II - LR 5

1. Vegetated - 0-9" free carbonates, 9-13" none.

2. Non-vegetated - 0-7" none, 7-12" free carbonates. Low chroma on surface.

3. Vegetated - 0-10" free carbonates, 10-12" none.

4. Non-vegetated - 0-11" non, 11-13" free carbonates.

REP II LR 3

1. Non-vegetated - 0-13" none. Low chroma on surface.

2. Vegetated - 0-4" free carbonates, 4-13" none.

3. Non-vegetated - 0-12" none, 12-13" free carbonates, low chroma on top.

4. Vegetated - 0-7" free carbonates, 7-13" none.

REP II - LR 1

1. Non-vegetated - 0-13" none, low chroma on surface.

2. Vegetated - 0-7" free carbonates

3. Non-vegetated - 0-7" none, 7-9" free carbonates, 7-13" none.

4. Vegetated - 0-1" free carbonates, 1-5" none, 5-6" free carbonates, 6-13" none.

REP II - LR 4

1. Vegetated - 0-12" free carbonates.

2. Non-vegetated - 0-5" none, 5-8" none, 8-13" none.

3. Vegetated - 0-2" free carbonates, 2-6" none, 6-7" free carbonates, 7-13" none.

4. Non-vegetated - 0-4" none, 4-8" free carbonates, 8-13" none.

REP II - LR 2

1. Non-vegetated - 0-8" none, 8-10" free carbonates, 10-13" none. L.C. material on surface.

2. Vegetated (thin) - 0-2" none, 2-3" free carbonates, 3-13" none.

3. Non-vegetated - 0-5" none, 5-6" free carbonates, 6-13" none.

4. Vegetated - 0-5" free carbonates, 5-13" none.

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REP III - LR 1

1. Non-vegetated - 0-13" no free carbonates, low chroma on surface.

2. Non-vegetated - 0-13" none, low chroma on surface.

3. Vegetated - 0-1" free carbonates, 1-5" none, 5-6" free carbonates, 6-13" none.

4. Vegetated - 5-6" free carbonates, only light vegetation.

REP III - LR 2

1. Vegetated - 0-3" free carbonates, 3-12" none.

2. Non-vegetated - 0-13" none. Low chroma materials on surface.
   NOTE: Few clovers on vegetated parts.

3. Vegetated - 0-5" free carbonates, 5-13" none.

4. Non-vegetated - 0-7" none, 7-8" free carbonates, 8-13" none.

REP III - LR 3

1. Vegetated - 0-2" free carbonates, 2-13" none.
   NOTE: Green weeping lovegrass on this site.

2. Non-vegetated - 0-13" none, L.C. on surface.

3. Vegetated - 0-3" free carbonates, 3-13" none.

4. Non-vegetated - 0-4" none, 4-8" free carbonates, 8-13" none.

REP III - LR 4 (Compression in tube to some degree, depths are approximate).

1. Vegetated - 0-4" free carbonates, 4-13" none.

2. Non-vegetated - 0-13" none.

3. Vegetated - 0-4" free carbonates, 4-13" none.

4. Non-vegetated - 0-7" none, 7-8" free carbonates, 8-13" none.

REP III - LR 5

1. Vegetated - 0-5" free carbonates, 5-13" none.

2. Non-vegetated - 0-9" none, 9-10" free carbonates and 10-12" none. L.C. on surface.

3. Vegetated - 0-5" free carbonates, 5-13" none.

4. Non-vegetated - 0-3" none, 3-6" free carbonates, 6-12" none.

REP IV - LR 3

1. Non-vegetated - 0-4" none, 4-6" free carbonates, 6-13" none.

2. Vegetated - 0-2" free carbonates, 2-6" none, 6-9" free carbonates, 9-13" none.

3. Vegetated - 0-5" free carbonates, 5-13" none. Some clover.

4. Non-vegetated - 0-5" none, 5-7" free carbonates, 7-13" none.

REP IV - LR 5 (Eroded plots)

1. Non-vegetated - 0-9" none, 9-10" free carbonates, 10-13" none.

2. Vegetated - 0-7" free carbonates, 7-13" none.

3. Non-vegetated - 0-7" none, 7-9" free carbonates, 9-12" none.

4. Vegetated - 0-3" free carbonates, 3-13" none.

REP IV - LR 4

1. Vegetated - 0-10" free carbonates, 10-13" none.

2. Non-vegetated - 0-4" none, 4-5" free carbonates, 7-9" free carbonates, 9-13" none.

3. Vegetated - 0-5" free carbonates, 5-13" none. Some clover.

4. Non-vegetated - 0-13" none.

REP IV - LR 1

1. Non-vegetated - 0-7" none, 7-8" free carbonates, 8-13" none.

2. Vegetated - 0-1" none, 1-4" free carbonates, (small amount), 4-13" none.

3. Vegetated - 0-1" no fizz, 1-8" free carbonates (small amount).

4. Non-vegetated - 0-3" none, 3-3.5" free carbonates, 3.5 - 7" none, 7-8" free carbonates, 8-13" none.

REP IV - LR 2

1. Non-vegetated - 0-6" none, 6-7" few free carbonates, 7-13" none.

2. Vegetated - 0-1" free carbonates, 1-13" none.

3. Vegetated - 0-1" few free carbonates, 1-13" none, clover.

3b. Vegetated - in clover - 0-1" free carbonates, 1-13" none.

4. Non-vegetated - 0-8" none, 8-9" free carbonates, 9-13" none.

APPENDIX D

Sampling Notes and Logs on Disposal Areas in the Divide Section

DISPOSAL AREA 1504

Sample Depths: Number 1, 0-4" and number 2, 4-8".

Sampled the southeasternmost portion of this disposal area (A-E), heavily vegetated with ser. lespedeza.

A1 A2	(0-4") (4-8")	Good organic litter. High chroma sandy loam. Good root growth from sericea (could be upper most matrix in section).
B1 B2	(0-4") (4-8")	South of the above, about 50 yards, high chroma material - sandy loam - sand. Good root growth.
C1 C2	(0-4") (4-8")	Down slope from the above high chroma loamy sand, incredible root growth.
D1 D2	(0-4") (4-8")	High chroma, loamy sand, good root growth. NOTE: all high chroma samples: common to many mica flakes.
E1 E2	(0-4") (4-8")	Lovegrass, sericea lespedeza, high chroma, loamy sand with few weathered dark gray shale.
F1 F2	(0-4") (4-8")	Bare. Are on lower slope in erosion. Wet acid spots. Will sample severe erosion. Some high and low chroma mixed materials, gray mudstone materials.
G1 G2	(0-4") (4-8")	High chroma dominant in upper part. Low chroma, 4-8 inch loosely consolidated sand, weak vegetation.
H1 H2	(0-4") (4-8")	Area void of vegetation only small patches exist. High chroma mixed with red mottles. Some carb material on surface. Mottled low chroma 4-8" layer.
I1 I2	(0-4") (4-8")	Vegetation but dying, green low chroma. Sandy loam-sand.
J1 J2	(0-4") (4-8")	Almost void of vegetation - few small areas. High and low chroma mixed with fine materials, fine sandy loam. Low chroma - sandy clay loam mixture.
K1 K2	(0-4") (4-8")	Low chroma, few high chroma in the 4-8 inch section, area void of vegetation.
L1 L2	(0-4") (4-8")	On Berm. Low and high chroma, mixed, sandy loam.
M1 M2	(0-4") (4-8")	High chroma with some low chroma completely void of vegetation. Fine sandy loam.

O1	(0-4")	Edge of vegetated area on north end. High chroma.
O2	(4-8")	Vegetation sparse, Ky - 31. Sandy, high & low chroma mixed.
P1	(0-4")	Heavily vegetated, Ky 31.
P2	(4-8")	Vigorous root growth in high chroma.
Q1	(0-4")	Area void of vegetation and eroding. Wet acid spots
Q2	(4-8")	evident, brown fine sandy loam. Some pebbles present, many fine flakes of mica.
R1	(0-4")	Vegetation dying - fescue in spots - below larger
R2	(4-8")	structure. High chroma, sandy loam or loam.

DISPOSAL AREA 1503

A1	(0-4")	Area void of vegetation (strip south end of pond).
A2	(4-8")	Low chroma 4-8" layer, fine sandy loam, upper portion contains higher chroma material.
B1 B2	(0-4") (4-8")	Area in fescue, hay mulch. Green material, more brown near surface, some carb.
C1 C2	(0-4") (4-8")	High chroma - low chroma, weak sand, scattered through - out fine sandy loam.
D1 D2	(0-4") (4-8")	High chroma top, low chroma bottom, vegetation dying on area.
E1	(0-4")	Very fine sandy loam, high chroma with low chroma spots in it. Bare area above pond.
E2	(4-8")	Very fine sandy loam, low and high chroma mixed.
F1	(0-4")	Mostly high chroma, very fine sandy loam, vegetated but stressed.
F2	(4-8")	Mostly high chroma, very fine sandy loam.
G1	(0-4")	Vegetated, 10YR5/4 (Yellowish brown) with 2.5YR5/2 (Grayish brown) few and scattered mottles. Excellent root penetration. Very many fine and very fine roots causing granular structure. Fine sandy clay loam. pH 5.5.
G2	(4-8")	Vegetated, 10YR5/4 (Yellowish brown) with 10YR5/8 (Yellowish brown) mottles. Common very fine roots. Wear subangular blocky and granular structure. Fine sandy clay loam. Large piece of carb. pH 4.0.
H1	(0-4")	Unvegetated, 2.5Y4/4 (Olive brown) with 10YR3/1 (very dark gray) common mottles. No roots. No structure evident. Very fine sandy loam. Hickory nut found in sample during processing. pH 4.0.
H2	(4-8")	Unvegetated, 10YR5/6 (Yellowish brown) with 2.5Y3/0 bedded mudstone, salt crystals on lamine planes. Many fine mica flakes. Very fine sandy loam. pH 4.0.
H3	(16-18")	Unvegetated, 5GY5/1 (Light greenish gray). Bedded mudstone 5Y5/2 - with green sand. Clay texture, no roots, pH 5.0.
I1	(0-4")	Vegetated, 10YR5/4 (Yellowish brown) 10YR6/8 (Brownish yellow) mottles. Fine sandy loam, common very fine roots. Granular structure. pH 7.5.

I2	(4-8")	Vegetated, few very fine roots - mudstone. 10YR5/6 (Yellowish brown) 7.5YR5/6 (Strong brown) and 2.5YR3/0 (Very dark gray) mudstone. Common to many fine mica flakes. pH 4.0. Many small black chert-like rocks (water worn).
J1	(0-4")	Vegetated, many fine - very fine roots. 10YR4/3 (Brown-dark brown). Clay loam texture, common fine mica flakes, granular structure. pH 6.5.
J2	(4-8")	Vegetated, large chert-like, water worn gravel in sample, large piece of wood present. Also common very fine roots. 10YR4/3 (Brown-dark brown). pH 4.0. Loam texture.
K1	(0-4")	Unvegetated, 10YR5/4 (Yellowish brown) lime dust visible in sample. Common fine mica flakes. Much partially decayed plant material visible. Loam texture. Granular structure. pH 4.0.
K2	(4-8")	Unvegetated, 2.5YR5/4 (Light olive brown) loam texture. No roots granular structured. pH 4.0.
K3	(8-12")	Unvegetated, 2.5YR3/2 (Very dark grayish brown) mudstone, massive structure. Many fine medium mica flakes. pH 4.0.
L1	(0-5")	Loam 10YR4/4, lime pocket in top. pH 4.0. Mudstone, no roots. NOTE: Scarce vegetation.
L2	(5-13")	Sandy loam, mottled 10YR6/8, 10YR5/1, 10YR5/6. No roots, mudstone. Layer is compacted. pH 4.0.
L3	(13-17")	5G4/1 fine sandy loam. Mudstone, highly compacted. pH 5.5. No roots.
M1	(0-5")	10YR4/4 common to many very fine roots. pH 4.3. NOTE: Well vegetated - fescue. Lime on surface.
M2	(5-10")	Loam 10YR4/4, 10YR5/6, pH 4.5. Layer compacted. NOTE: Well vegetated - fescue. Lime on surface.

DISPOSAL AREA 501 NORTHERN END

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DA 501 - A1	(0-4")	10YR5/3, loam, common very fine roots. Chert and rounded quartz gravels. Tight - hard to dig. pH 6.5. NOTE: Area burned over - vegetation coming in well.
DA 501 - A2	(4-8")	Loam, 7.5YR5/6 mottles. Chert and rounded quartz gravels. Very few to no roots. pH 4.0.
DA 501 - B1	(0-6")	Gravelly loam 10YR5/3. pH 5.5. Many fine and very roots - high percentage of chert gravels, very hard to dig. NOTE: Area has series of depressions that are wet.
DA 501 - B2	(6-10")	Gravelly loam 10YR5/4; 10YR5/2 mottles, 7.5YR5/0. Gravel content picks up with roots growing between gravels. pH 4.5.
DA 501 - C1	(0-4")	10YR5/6 Matrix, gravelly loam. 10YR4/3 mottles. Many very fine and fine roots in 0-4". pH 5.5. Roots growing between gravels.
DA 501 - C2	(4-8")	10YR4/4 matrix, gravel loam. 10YR4/1 mottles. 7.5YR5/6 mottles. Common very fine and fine roots to bottom. High percentage of chert gravels in both layers. pH 5.5.
DA 501 - D1	(0-6")	10YR4/3 fine sandy loam, roots many very fine to fine to 11" and continues past bottom of pit. pH 8.0.
DA 501 - D2	(6-11")	10YR5/4 fine sandy loam, 7.5YR5/8 mottles and 10YR5/2. Many chert gravels present. Roots growing between gravels. pH 4.0.
DA 501 - E1	(0-4")	10YR5/4, 10YR7/2 and 5/8 mottles. Common roots to 5", fine and very fine. pH 6.0. Sandy loam. NOTE: Abundant chert and quartz although pit was easily dug. Soil is soggy and loose with few coarse fragments present in samples. Unburned area - fair stand of wheat most about 3" tall.
DA 501 - E2	(4-9")	10YR5/3, 7.5YR5/8 and 5Y5/4 mottles. Sandy loam. pH 4.0. No roots below 5".
DA 501 - E3	(9-13")	2.5YR5/2, 7.5YR5/8 and 2.5Y6/4 mottles. Sandy loam.

DA 501 - F1	(0-4")	10YR5/3, few fine roots. 7.5YR5/8, 10YR6/2 mottles loam. pH 4.0. NOTE: Pit very soggy. Unburned - wheat coming up, broom sedge spotty.
DA 501 - F2	(4-8")	Clay loam, same colors as F1. Compact layer. pH 4.0. Rained out.

Tennessee Tombigbee
July 12, 1982
DA 501 - Finish Sampling

501

G1	0-1": 10YR6/6, loam, many fine and very fine roots concentrated in the surface inch. Vegetation sparse - looks moisture stressed.
G2	1-6": 10YR6/6, 10YR6/3 and 7.5YR5/8, mottled, sandy clay loam, few fine and very fine roots along planes of weakness, rootmats highly visible in this area.
H1	0-4": 10YR4/4, loam, many fine and medium roots, moderate vegetation.
H2	4-8": 10YR6/6, 7.5YR5/9, loamy sand, mottled, few very fine roots - very loose consistence.
I1	0-4": 10YR5/4, loam, 10YR6/3 mottled, many very fine and fine roots.
I2	4-8": 10YR5/6, loam, common fine and very fine roots 10YR6/2 mottled. Layer is a little more firm.
J1	0-1": 10YR4/4 - gravelly loam, no roots to very few roots.
J2	1-5": 10YR5/6, gravelly loam, no roots.
Notes:	J1 - J2 - some ferroconglomerate on site possibly from Gordo formation. Also carb present.
K1	0-4": 7.5YR5/8 mottles, matrix 10YR5/6, loam, few to common very fine and fine roots, grass appears to be stressed. Moderate vegetation.
K2	4-8": mottles 7.5YR5/0, matrix 7.5YR5/8; loamy texture, roots are few to none observable, 10YR6/2 mottled (mudstone).
L1	0-4": 5YR4/8, gravelly loam, no roots, no vegetation.
L2	4-8": 5YR4/8, gravelly loam, no roots. White mudstone (loamstone present).
Notes:	Apparently these are influenced by conglomerate rocks partially weathered - some still quite solidified - probably Gordo formation.
M1	0-4": 10YR5/4 with 10YR7/2 mottled. Loam, roots common fine to medium. Mostly lespedeza - area burned over.

M2	4-8": 10YR5/6, 5/8, 6/2 mottles; sandy clay loam, common roots - fine to medium. Mudstone common. NOTE: rootmats evident and common.
N1	0-4": 7.5YR5/8 and 5GY6/1 mottles, sparse vegetation, gravelly very fine sandy loam; few very fine roots.
N2	4-8": 10YR6/8, sandy loam, no observable roots. Some 10YR7/2 "sandy loamstone".
O1	0-3": 10YR5/6 loam, many fine and medium roots, lovegrass - some sericea.
O2	3-8": 10YR4/4, 5/6, loam and fine sandy loam, rootmats on the faces of the coarse fragments along planes of weakness. Roots common very fine and fine to 3 inches and then none.
P1	0-3": mottles 10YR7/2, 7.5YR3/8, 10YR5/6 loam, heavily vegetated lespedeza, area burned over.
P2	3-8": mottles 10YR7/2, 7.5YR5/8, 10YR5/6, highly compacted - no roots.

(Area has been burned off.) <u>Logged in Lab</u>

DISPOSAL AREA 1704

4 - 3 - 82

DA 1704 - A1	(0-4")	2.5Y6/6 with 5YR5/8 mottles. Sandy clay loam. pH 6.5 - 5.5. Common to many fine and very fine roots.
DA 1704 - A2	(4-8")	2.5Y5/6 sandy clay loam. 2.5Y6/2 mottles. Common fine and very fine roots. pH 5.5. Few to common mica flakes.
DA 1704 - B1	(0-6")	2.5Y6/1, 2.5Y6/6. Prominent 5Y5/8 mottles along planes of weakness. pH 6.5. Rootmats - along weakness planes. Appears to be very dense. (Vegetated).
DA 1704 - B2	(6-12")	2.5Y4/0 clay, 5YR5/8 oxidation exterior. Roots matted on the planes of weakness along oxidation planes. pH 5.5 - 6.0.
DA 1704 - B3	(2-6")	Stuck in B1, vein in pit. 10YR5/2 clay. Dense, few roots pH 5.5. NOTE: More silt in this sample. Common very fine mica flakes.
DA 1704 - C1	(0-4")	2.5Y5/6, loam - sandy loam. Many very fine roots. pH 6.0. (Vegetated)
DA 1704 - C2	(4-8")	Sandy loam 5Y5/1, 7.5YR5/8, mottled. pH 4.5 - 5.0. Sample loose - few very fine roots.
DA 1704 - D1	(0-4")	10YR5/1 - 10YR5/4 mottles, 7.5YR5/8 mottles, sandy clay loam. pH 6 to 7. Common fine and very fine roots. (Well Vegetated).
DA 1704 - D2	(4-8")	2.5Y5/1, 5YR5/8, 2.5Y5/6, mottled. Sandy clay. pH 5.5. Roots common and very fine. Comes apart in chunks.
DA 1704 - E1	(0-4")	2.5Y5/4, 7.5YR5/8 mottle. Sandy loam. Many roots, evidently area well vegetated until burned, poor recovery so far. pH 5.5. Roots growing along planes of weakness. (Unvegetated).
DA 1704 - E2	(4-8")	2.5Y5/4, 2.5Y6/1, 5YR5/8 mottles. Loam. Roots few very fine. pH 5.5.
DA 1704 - F1	(0-4")	5G5/1, 2.5Y5/6, sandy loam, mottled. pH 8.0. Few roots. Club moss on surface and that is it. (Vegetated) Moss.

DA 1704 - F2	(4-8")	5Y4/1, Loamy sand, few roots. pH 4.5.
DA 1704 - G1	(0-4")	2.5Y5/6 loam. Many fine roots. pH 7.0. (Vegetated) Fescue.
DA 1704 - G2	(4-8")	2.5Y5/4 loam with 5.YR5/8 mottles. Common to many roots. pH 7.0.
DA 1704 - H1	(4-8")	2.5Y5/4, 2.5Y6/1 and 5YR5/8 mottles. Fine sandy loam to loam. Many very fine roots, few fine roots. pH 5.5 - 7.5. (Vegetated)
DA 1704 - H2	(4-8")	Mottled 2.5Y5/6, 10YR7/2, 5YR5/8. Sandy clay loam to sandy clay. Few roots along planes of weakness. Mudstone evident. Oxidation on mudstone core exterior. pH 4.5.

COMMENTS

DA 1704 - B3	Sample is dark vein running through the normal matrix, which extended 0-7". Samples separately from 2-6". Clay loam.
DA 1704 - C	Small area, vegetated covered with leguminious growth (some visible nodules on roots). Hairy vetch.
DA 1704 - E	This area was apparently well vegetated until burned. Recovery very poor.
DA 1704 - F	Vegetated. Large amounts of mossy plant growth. Club moss.
DA 1704 - G	Vegetated. Large chunk of limestone (fizz) at site. Soil fizzed when tested with acid.

3 - 22 - 82

Arrived in the afternoon, sampled DA 1704. Described pit and too physical and chemical samples.

NOTE: In this disposal area there is a higher content of clayey material. It was observed in the pit and during field sampling.

DISPOSAL AREA 1203

3 - 24 - 82

Sampling on DA 1203 area is varied with some acid spots evident - dead vegetation and some wet spots.

DA 1203 - A1	(0-4")	Loam 2.5Y4/4, 7.5YR5/8 mottle. Common roots to bottom of pit. pH 4.0. Mixture of gray mudstone in pit. NOTE: Vegetation dead - or appears to be.
DA 1203 - A@	(4-8")	2.5Y4/4, 2.5YR4/4 mottle. Many gray mudstone. 7.5YR5/3 mottle. pH 4.0.
DA 1203 - B1	(0-3")	2.5Y5/4, 7.5YR5/8 mottle. Fine sandy loam, few to common very fine roots. pH 6.5.
DA 1203 - B2	(3-8")	5YR5/6, fine sandy loam. pH 4.5. Few to common very fine roots.
DA 1203 - C1	(0-6")	5Y4/4, sandy loam. Roots quit at 6". pH 8.0. Top 6" very wet. NOTE: Just north of riprap drain.
DA 1203 - C2	(6-10")	5YR4/6 mottled, sandy loam, 10YR5/6, N 4/0. pH 4.0. Layer is dense - no roots. NOTE: Partially vegetated with wheat.
DA 1203 - D1	(0-5")	5Y4/4 fine sandy loam, 2.5Y5/6 mottle. Roots quite at 7". pH 5.0. NOTE: Vegetated are just east of entrance. Wheat - some legumes.
DA 1203 - D2	(5-9")	2.5Y5/6 loamy sand, 5BG4/1 mottles. pH 5. Hard compacted layer at 11". NOTE: East down slope from Link sample.
DA 1203 - E1	(0-5")	2.5Y4/4 - sandy loam. Roots to be 5". pH 7.0. NOTE: Well vegetated with wheat.
DA 1203 - E2	(5-9")	2.5Y4/4 - sandy clay, 2.5y5/2 mottles, 7.5YR5/8 mottles. Very dense layer in bottom. pH 4.0. NOTE: Well vegetated with wheat.
DA 1203 - F1	(0-4")	2.5Y4/4 - fine sandy loam. pH 8.0. Many fine roots. NOTE: Well vegetated.
DA 1203 - F2	(4-8")	2.5Y4/4, 2.5 N/0 sandy clay loam. ph 4.0. Roots to 8". Many fine roots 0-5".

DA 1203 - G1	(0-4")	2.5Y5/6 loamy sand, 7.5YR5/8 mottle. Roots to 7". Mudstone prominent below 8". NOTE: Vegetation dead - residue on surface.
DA 1203 - G2	(4-8")	2.5Y5/6 loamy sand, 7.5YR5/8. pH 4.0. No roots below 7".
DA 1203 - H1	(0-4")	2.5Y5/6 loamy sand, 7.5YR5/8 mottles. No roots. Gray mudrock - fissle shale. pH less than 4.0. NOTE: Area completely void of vegetation.
DA 1203 - H2	(4-8")	2.5 5/6 loamy sand, 7.5YR5/8 mottles. pH less than 4.0. NOTE: This area appears to be extremely acid - erosional gullies starting - exposing gray mudstones.
DA 1203 - I1	(0-4")	2.5Y4/4 sandy loam. Lime concentrated at surface. Many fine roots - mudstone fragments. pH 8.0. NOTE: Vegetated wheat and fescue.
DA 1203 - I2	(4-8")	2.5Y4/4 sandy loam. pH 4.0. Gray mudstone 2.5 4/0. Roots stopped at 9".
DA 1203 - J1	(0-4")	5Y4/4 sandy loam. pH 8.0. Roots to 5". Greenish mudstone in bottom of pit. NOTE: Vegetation appears dead.
DA 1203 - J2	(4-8")	5Y5/6 loamy sand, 5Y5/1 mottles, 7.5YR5/8 mottles. pH less than 4.0.
DA 1203 - K1	(0-4")	5Y5/6 loamy sand, 7.5YR5/8 mottles. Many very fine roots. pH 8.0. NOTE: Little if no vegetation.
DA 1203 - K2	(4-8")	5Y5/6 sandy loam, 7.5YR5/6 mottle. pH 4.0. No roots. Thick mudstone at 10".
DA 1203 - L1	(0-4")	Sandy loam, mottled, 5Y4/4, 7.5YR5/8, 5Y5/6, 5Y4/1. pH 8.0. NOTE: Dead vegetation.
DA 1203 - L2	(4-8")	5YR4/4. Gray mudstone at 4". pH 4.0. Gray mudstone - bottom of pit. NOTE: Dead vegetation.
DA 1203 - M1	(0-5")	5Y4/4 sandy loam. Roots to 5" - Many very fine and fine, few medium. pH 8.0.
DA 1203 - M2	(5-9")	5Y5/6 sandy loam. Some mudstone mixed in layer. pH 4.0.

1203 - N1	(0-4")	2.5Y4/4 sandy loam. Mudstone 5Y4/0. pH 8.0. Many fine and very fine roots. NOTE: Vegetated - fescue and wheat.
DA 1203 - N2	(4-8")	2.5Y4/4 sandy loam. Many fine and very fine roots. Roots to 9". Loose. pH 4.5. NOTE: Vegetated - fescue and wheat.
DA 1203 - O1	(0-4")	2.5Y4/4 sandy loam. pH 8.0. Some gray mudstone. NOTE: Vegetated.
DA 1203 - O2	(4-11")	2.5Y4/4, 2.5Y4/2 mottles. pH 4.0. Roots to 9". NOTE: Vegetated.
DA 1203 - O3	(11-15")	Mudstone at 11½". 5BG 4/1. Sample taken. pH 6.5. No roots.
DA 1203 - P1	(0-4")	2.5Y4/4 sandy loam. Some mudstone (fissle shale). pH 8.0. Many fine roots.
DA 1203 - P2	(4-8")	2.5Y4/4 sandy loam. Roots to 8". pH 4.5.
DA 1203 - Q1	(0-4")	2.5Y5/6 fine sandy loam, 10YR5/8 mottles. No roots. pH less than 4.0. NOTE: No vegetation.
DA 1203 - Q2	(4-8")	2.5Y5/6; 10YR5/8 mottles. pH less than 4.0. Mudstone. No roots. NOTE: No vegetation.
DA 1203 - R1	0-4"	2.5Y4/4 fine sandy loam, 7.5 YR5/8 mottles. Many fine and very fine roots. pH less than 4.0. NOTE: Vegetation died back?
DA 1203 - R2	4-8"	2.5Y4/4 sandy loam. Many fine and very fine roots. pH less than 4.0. Roots down to 13".

DISPOSAL AREA 1204

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Sampling on DA 1204. No profile samples - vegetation - fescue and some wheat.

NOTE: Areas have recently had surface liming. Yellowish sand used for topping on some areas of DA 1204.

DA 1204 - A1	(0-4")	5Y4/4, fine sandy loam. pH 4.0 - 4.5.
DA 1204 - A2	(4-8")	5Y4/4, fine sandy loam. pH 4.0 - 4.5. Few low chroma mudstones.
DA 1204 - B1	(0-4")	5YR5/4, fine sandy loam. pH 5.5. No vegetation - recently limed.
DA 1204 - B2	(4-8")	5YR4/4, sandy loam, few gray mudstone. pH 5.5.
DA 1204 - C1	(0-5")	5YR4/4, fine sandy loam, fescue and wheat. Very fine to fine roots (Common to many) pH 8.0.
DA 1204 - C2	(5-10")	5Y4/4 mottled, 5Y6/8, fine sandy loam, few medium roots. pH less than 4.0.
DA 1204 - D1	(0-5")	5Y5/9, fine sandy loam, common very fine to fine roots. pH 6.0. Sparsely vegetated - wheat, some fescue. Lime on surface. Shark's tooth.
DA 1204 - D2	(5-10")	5Y4/4 - 10YR5/5 mottle. Fine sandy loam, gray mudstone present. No roots present. pH 4.0 - 4.5.
DA 1204 - E1	(0-8")	5Y4/4, fine sandy loam, many very fine to fine roots. Vegetation in wheat and some fescue. pH 4.5. Few gray mudstone. NOTE: This site close to one of Linkinhokers samples.
DA 1204 - E2	(8-14")	5Y5/4 - 10YR5/8 mottles, sandy loam. Common to many mudstone. Few to no roots. (Very fine). pH 4.5. Roots stopped at mudstone at 8". NOTE: This site close to one of Linkinhokers samples.

DA 1204 - F1	(0-4")	5Y4/4, fine sandy loam, heavily vegetated. pH 7.0. Roots very fine to fine - common to many. NOTE: Wheat and legumes (red clover) are sparse. No nodules observed on roots. Site located near slough drain.
DA 1204 - F2	(4-8")	5YR4/4, fine sandy loam, root penetration to 15". pH 5.0.
DA 1204 - G1	(0-6")	5Y4/3, fine sandy loam, pH 8.0, 7.5YR5/2 mottles. Thin laminated mudstones. Heaviest root growth fine and very fine. Tremendous stand of wheat, some legumes.
DA 1204 - G2	(6-12")	5Y4/3, fine sandy loam, pH 5.5. Laminated mudstone present at very bottom (about 12").
DA 1204 - G3	(12")	2.5YR5/0, fine sandy loam, pH 6.0. No roots - mica.
DA 1204 - H1	(0-7")	5Y4/4, fine sandy loam, many fine roots. Wheat - good vegetation. pH 8.0.
DA 1204 - H2	(6-12")	5Y4/4, fine sandy loam. pH 4.0. NOTE: Mudstone 8" - root penetration to 8" - many fine roots. Mudstone concentrated in this layer. Ag lime - thin band at 15".
DA 1204 - H3	(12-15")	5Y5/3, sandy loam - lime present - visible. pH off scale - high.
DA 1204 - I1	(0-4")	5Y4/4 mottles - 5YR5/8, fine sandy loam. Dead vegetation. Chunks of wood, mudstone present. Few medium roots. pH less than 4.0.
DA 1204 - I2	(4-8")	10YR5/6 - 5YR4/2 mottles loam, few roots down to 8". pH less than 4.0. Gray mudstones present.
DA 1204 - J1	(0-4")	5Y4/4 mottles 5Y5/6, 5YR5/8, fine sandy loam, roots concentrated in this layer. pH less than 4.0.
DA 1204 - J2	(4-8")	5Y5/6, fine sandy loam, 5YR5/8, 2.5Y4/8 mottles. Many mudstones. pH less than 4.0.
DA 1204 - K1	(0-4")	2.5Y4/4, fine sandy loam. Many fine and very fine roots. pH 7.0. Wheat and some fescue.
DA 1204 - K2	(4-8")	2.5Y4/4, fine sandy loam. Many fine and very fine roots. Mudstone comes in at 14" - fairly solid. pH 4.0. Wheat and some fescue.

DA 1204 - L1	(0-4")	2.5Y4/4, fine sandy loam. Few to common roots - concentrated in this layer. pH 4.0. NOTE: Vegetation died back.
DA 1204 - L2	(4-9")	2.5Y4/4, fine sandy loam. 2.3YR5/6 mottle 2.5Y4/0. No roots. pH 4.0. NOTE: Vegetation died back.
DA 1204 - L3	(9-13")	Greasy (mica) sandy loam 5BG4/1, pH 5.5, 2.5Y5/6 mottles. No roots, gray mudstone.
DA 1204 - M1	(0-4")	5Y5/6 with 5Y4/4 mottles, fine sandy loam. Many very fine and fine roots. pH 4.0. NOTE: Dead vegetation.
DA 1204 - M2	(4-8")	5Y5/4, 5YR5/8 mottle, 5Y5/2, fine sandy loam. Many very fine and fine roots. pH 4.0. NOTE: Dead vegetation.
DA 1204 - N1	(0-4")	5Y5/6, fine sandy loam, 5YR5/8 mottle. many to common fine roots. pH 8.0 NOTE: Dead vegetation.
DA 1204 - N2	(4-8")	5Y5/6 mottles, 5YR5/8, 5Y6/2. Many very fine roots. pH 4.0. Area near pond. NOTE: Dead vegetation.
DA 1204 - O1	(0-5")	5Y4/4, fine sandy loam. Many very fine roots. pH 5.0 NOTE: Well vegetated.
DA 1204 - O2	(5-10")	5BG4/1, 7.5YR5/6, sandy loam. No roots - grayish mudstone partially weathered. pH 7.0.
DA 1204 - P1	(0-4")	2.5Y4/4, 7.5YR5/0 and 2.5Y6/8 mottles. Many roots - fine and very fine to 9". NOTE: Very well vegetated, wheat & legumes present.
DA 1204 - P2	(4-8")	2.5Y4/4, 2.5Y6/8 mottles, fine sandy loam, many fine and very fine roots. pH 4 - 4.5.
DA 1204 - Q1	(0-4")	2.5Y4/4 - fine sandy loam, 7.5YR5/8 mottles. pH 7.0. Many roots. Vegetated - wheat.
DA 1204 - Q2	(4-9")	2.5YR4/4 - sandy clay loam. pH 4.5. No roots. Vegetated - wheat.
DA 1204 - Q3	(9-13")	5G4/1 - sandy loam. pH 6.0 - no roots. 5YR5/8 dense. Vegetated - wheat.

DA 1204 - R1	(0-4")	2.5Y5/4 - loamy sand. pH 8.0, 10YR6.8 mottles. Roots to 8" - fine and very fine - common. Loose and friable.
DA 1204 - R2	(4-8")	2.5Y5/4 - loamy sand. pH 4.0. Many fine and very fine roots.

APPENDIX E

Chemical Characterization Data not Used in Text of the Report.

Includes Sampling by Corps of Engineers Personnel.

LEGEND FOR NUTRIENT STATUS LABORATORY WORK SHEET

Sample number - laboratory sample number.

1:1 pH - pH from 1:1 (sample:water) ratio.

K* - amount of acid extractable potassium in sample in lbs/1000 Tons of material.

0 - 60	Low
61 - 120	Medium
121 - 240	High
241 -	Very High

Ca* - amount of acid extractable calcium in sample in lbs/1000 Tons of material.

0 - 1000	Low
1001 - 2500	Medium
2501 - 4000	High
4001 -	Very High

Mg* - amount of acid extractable magnesium in sample in lbs/1000 Tons of material.

0 - 100	Low
101 - 250	Medium
251 - 500	High
501 -	Very High

Acid extractable phosphorus* - amount of acid extractable phosphorus in sample in lbs/1000 Tons of material (approx. lbs/acre).

0 - 25	Low
26 - 50	Medium
51 - 80	High
81 -	Very High

Bicarbonate extractable phosphorus* - amount of bicarbonate extractable phosphorus in sample in parts per 2 million (pp2m).
NOTE: pp2m = lbs/1000 Tons of material.

0 - 10	Low
10 - 20	Medium
20 -	High

* - Ratings for the given numerical values are from Jackson, M.L. 1958. Soil Chemical Analysis. Prentice-Hall, Inc., Englewood Cliffs, N.J.

TABLE _____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Munsell Fizz	Color (powder)	$CaCO_3$ Equivalent Tons/1000 Tons Material %S	Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
601A-03	1	0-6"	6.5	Slight	10YR6/3	.0230	.72	3.28		2.56
6024-04	2	0-6"	6.3	Slight	2.5Y7/2	.0152	.48	.94		.46
602A-07	3	0-6"	4.9	None	10YR7/6	.0090	.28	.47		.19
501-02	4	0-6"	4.6	None	10YR6/4	.0242	.76	-.07	1.46	
501-04	5	0-6"	4.1	Slight	10YR6/4	.4554	14.23	.47	13.76	
501-07	6	0-6"	4.3	None	10YR6/4	.0325	1.02	0.00	1.02	
503	7	0-6"	4.7	Slight	2.5Y7/4	.0246	.77	.70	.07	
503-N	8	0-6"	5.8	Moderate	2.5Y6/4	.0135	3.23	10.75		7.52
503	9	0-6"	5.0	Slight	10YR7/3	.0343	1.07	2.12		1.05
503-S	10	0-6"	4.8	Slight	2.5Y6/4	.0765	2.39	.24	2.15	
EWFS	11	0-6"	5.4	Moderate	2.5Y6/4	.1454	4.54	6.21		1.67
802	12	0-6"	4.4	Slight	2.5Y6/4	.0589	1.84	.96	.88	
802	13	0-6"	4.8	Slight	2.5Y6/4	.0256	.80	.46	.34	
803-N	14	0-6"	3.2	Slight	2.5Y6/4	.1344	-2.15	6.35		

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
803-C	15	0-6"	4.3	Slight	10YR6/4	.0206	.64	.24	.40	
1003-B	16	0-6"	6.0	Moderate	2.5Y6/4	.0531	1.66	11.23		9.57
1201-NW	17	0-6"	6.3	None	5Y6/3	.0566	1.77	5.49		3.72
1201-SW	18	0-6"	6.7	Moderate	10YR5/6	.0243	.76	10.99		10.23
1203-SW	19	0-6"	5.5	Slight	2.5Y7/4	.0420	1.31	3.83		2.52
1203-NW	20	0-6"	5.5	Moderate	5Y6/3	.0546	1.71	6.79		5.08
1302-B-01	22	0-6"	3.5	None	5Y5/3	.0570	1.78	-.60	2.38	
1302-B-02	23	0-6"	5.7	Moderate	2.5Y6/4	.0109	.34	5.84		5.50
1302-A-01	24	0-6"	5.9	Strong	2.5Y6/4	.0990	3.09	8.93		5.84
1302-A-02	25	0-6"	5.3	Slight	5Y6/2	.0078	.24	1.31		1.07
1304-N	26	0-6"	6.3	Moderate	5Y6/1	.0326	1.02	5.84		4.82
1304-CE	27	0-6"	5.0	Slight	2.5Y6/4	.0770	2.41	4.17		1.76
1304-SW	28	0-6"	6.1	None	10YR7/6	.0102	.32	1.79		1.47
1304-SW	28	0-6"	6.1	None	10YR7/6	.0102	.32	1.79		1.47

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
							Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1304-SE	29	0-6"	6.8	Strong	10YR6/4	.0743	2.32	11.79		9.47
1509-02	30	0-6"	2.5	None	10YR6/3	.2221	6.94	-5.84	12.18	
1509-03	31	0-6"	6.4	Moderate	2.5Y5/4	.0246	.77	9.88		9.11
1509-01	32	0-6"	2.3	None	10YR6/4	.2108	6.59	-5.36	11.95	
1508-02	33	0-6"	6.5	Moderate	2.5Y6/4	.0380	1.16	15.17		14.01
1508-04	34	0-6"	5.6	Strong	2.5Y6/4	.1410	4.41	15.17		10.76
1508-03	35	0-6"	6.3	Strong	2.5Y6/4	.1362	4.26	20.75		16.49
1508-05	36	0-6"	6.2	Moderate	10YR6/4	.2196	6.86	18.27		11.41
1506-02	37	0-6"	3.0	Slight	2.5Y6/4	.2248	7.03	-2.48	9.51	
1506-03	38	0-6"	3.9	Slight	2.5Y6/4	.3097	9.68	- .93	10.61	
1505-02	39	0-6"	3.3	None	10YR6/4	.0350	1.09	-2.48	3.57	
1505-01	40	0-6"	4.3	None	5Y6/3	.0322	1.01	-1.55	2.56	
1704-01	41	0-6"	6.5	None	5Y6/2	.0513	1.60	4.64		3.04
1704-03	42	0-6"	4.2	None	2.5Y6/4	.0111	.35	- .62	.97	

TABLE _____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
							Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1706-01	43	0-6"	3.1	None	2.5Y7/4	.0590	1.84	-2.48	4.32	
1706-02	44	0-6"	5.1	None	10YR7/4	.0090	.28	- .62	.90	
1503-05	45	0-6"	6.2	Strong	2.5Y6/4	.1345	4.20	27.97		23.77
1503-06	46	0-6"	5.8	Strong	2.5Y6/4	.1400	4.38	21.78		17.40
1503-02	48	0-6"	5.0	Slight	2.5Y6/4	.0220	.69	6.65		5.96
1504-04	49	0-6"	5.2	Strong	5Y6/1	.0523	1.63	6.19		4.56
1504-03	50	0-6"	2.5	None	2.5Y6/4	.0999	3.12	0.00	3.12	
1504-01	51	0-6"	6.0	Slight	2.5Y6/4	.0096	.30	7.34		7.04
1504-02	52	0-6"	3.9	Slight	10YR7/4	.0927	2.90	4.13		1.23
1507-03	53	0-6"	4.2	None	10YR6/4	.0435	1.36	4.13		2.77
1507-04	54	0-6"	5.2	Slight	2.5Y6/2	.0247	.77	5.50		4.73
1507-02	55	0-6"	3.3	None	2.5Y6/4	.2930	9.16	1.38	7.78	
1507-01	56	0-6"	4.1	None	2.5Y6/4	.0236	.74	4.58		3.84
1701-01	57	0-6"	4.3	None	2.5Y6/4	.0169	.53	-1.07	1.60	

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
							Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1701-05	58	0-6"	6.9	Moderate	5y6/3	.0213	.67	3.52		2.85
1701-06	59	0-6"	5.5	Slight	10YR6/6	.0080	.25	1.68		1.43
1702-01	60	0-6"	6.4	None	10YR6/6	.0154	.48	7.49		7.01
1702-03	61	0-6"	4.9	Slight	5Y6/2	.0131	.41	1.99		1.58
1703-01-01	62	0-6"	4.5	Slight	2.5Y6/4	.0192	.60	.76		.16
1703-C1-02	63	0-6"	4.3	None	5Y6/3	.0082	.26	.46		.20
805A-NW	73	0-6"	4.8	Slight	2Y6/2	.1299	4.06	2.59	1.47	
804	74	0-6"	4.4	Slight	5Y6/2	.1431	4.47	2.60	1.87	
T. Hill	75	0-6"	5.2	Slight	7.5YR6/6	.0176	.55	1.99		1.44
1204-N	76	0-6"	6.1	Moderate	2.5Y6/4	.0467	1.46	7.49		6.03
1204-SW	77	0-6"	6.0	Slight	5Y6/3	.0318	.99	4.13		3.14
1204-E	78	0-6"	3.8	Slight	2.5Y6/4	.0534	1.67	2.90		1.23
1205-01	79	0-6"	6.8	Slight	5Y6/3	.0088	.28	5.48	5.20	
1205-05	80	0-6"	3.6	None	2.5Y6/4	.1275	3.98	-2.86	6.84	

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
							Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1501-01	81	0-6"	3.2	None	5Y6/3	.2149	6.72	-2.62	9.34	
1501-05	82	0-6"	7.1	Slight	5Y6/2	.0194	.61	12.15		11.54
1501-07	83	0-6"	5.7	Slight	2.5Y6/2	.0762	2.38	4.29		1.91
1205-07	84	0-6"	6.4	Moderate	2.5Y6/4	.0189	.59	7.15		6.56
1303-01	85	0-6"	6.6	Slight	2.5Y6/4	.0081	.25	5.96		5.71
1303-07	86	0-6"	7.3	Moderate	5Y6/1	.0289	.90	20.25		19.35
1303-04	87	0-6"	6.8	Moderate	2.5Y6/2	.0094	.29	4.29		4.00
1705-B-02	88	0-6"	4.8	None	2.5Y6/4	.0175	.55	.48	.07	
1705-B-03	89	0-6"	5.1	Slight	2.5Y6/4	.0171	.53	1.67		1.14
1705-A-02	90	0-6"	5.9	Moderate	5Y6/2	.0169	.53	2.62		2.09
1705-A-04	91	0-6"	4.2	Slight	10YR6/3	.0314	.98	- .24	1.22	
No Tag		0-6"	4.3	None	5y6/2	.0746	2.33	- .48	2.81	

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH(1:1)	Bi-carb P (PP2M)	K	Lbs./1000 Tons Ca	Mg	Na
601A-03	1	0-6"	6.0	13.1	166	2189	164	22
602A-04	2	0-6"	6.2	56.0	172	1870	185	22
602A-07	3	0-6"	4.7	10.2	216	775	492	27
501-02	4	0-6"	4.7	24.0	246	1733	233	28
501-04	5	0-6"	3.5	69.0	60	7250	413	26
501-07	6	0-6"	4.2	23.5	136	1231	185	23
503	7	0-6"	4.3	29.9	338	1733	185	24
503-N	8	0-6"	5.2	55.3	198	10807	297	35
503	9	0-6"	4.3	26.3	266	2234	205	18
503-S	10	0-6"	4.4	41.7	184	2280	422	23
EWFS	11	0-6"	4.6	14.0	70	7114	237	28
802	12	0-6"	3.8	14.9	140	1482	169	22
802	13	0-6"	4.2	16.0	160	1368	119	20
803-N	14	0-6"	3.2	24.6	152	2417	392	36

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH(1:1)	Bi-carb P (PP2M)	K	Lbs./1000 Tons Ca	Lbs./1000 Tons Mg	Na
803-C	15	0-6"	4.3	29.5	278	1596	244	29
1003-B	16	0-6"	6.0	34.9	422	9029	379	47
1201-NW	17	0-6"	5.5	28.0	274	3899	397	33
1201-SW	18	0-6"	6.0	28.0	272	6931	495	32
1203-SW	19	0-6"	4.5	9.5	198	3169	365	41
1203-NW	20	0-6"	4.8	42.7	398	6361	353	25
1302B-01	22	0-6"	3.4	67.0	146	1619	153	21
1302B-02	23	0-6"	5.4	33.5	342	4902	420	39
1302A-01	24	0-6"	4.7	59.1	402	8573	627	30
1302A-02	25	0-6"	4.4	13.9	304	1664	559	19
1304-N	26	0-6"	4.8	21.3	234	9143	239	17
1304-CE	27	0-6"	4.3	24.0	226	4286	326	29
1304-SW	28	0-6"	5.9	12.2	172	1961	415	23
1304-SE	29	0-6"	6.4	13.9	202	7638	522	28
1509-02	30	0-6"	2.4	16.2	60	2462	490	14

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH(1:1)	Bi-carb P (PP2M)	K	Lbs./1000 Tons Ca	Lbs./1000 Tons Mg	Na
1509-03	31	0-6"	5.1	22.5	294	5654	326	28
1509-01	32	0-6"	2.5	8.3	64	1300	360	22
1508-02	33	0-6"	6.1	20.9	210	14957	182	31
1508-04	34	0-6"	4.9	35.5	376	11514	137	20
1508-03	35	0-6"	5.9	9.9	166	15686	324	26
1508-05	36	0-6"	4.5	12.8	104	16120	481	20
1506-02	37	0-6"	2.9	12.7	94	3853	319	15
1506-03	38	0-6"	3.9	14.0	174	4446	627	35
1505-02	39	0-6"	3.3	7.5	140	821	280	23
1505-01	40	0-6"	3.8	33.7	166	1163	171	16
1704-01	41	0-6"	4.8	38.4	216	3329	285	21
1704-03	42	0-6"	4.1	35.8	234	1254	349	18
1706-01	43	0-6"	2.9	21.7	52	889	153	25
1706-02	44	0-6"	5.2	24.0	386	1505	153	22
1503-05	45	0-6"	4.3	22.3	284	14159	534	27

TABLE _____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH(1:1)	Bi-carb P (PP2M)	K	Lbs./1000 Tons Ca	Lbs./1000 Tons Mg	Na
1503-06	46	0-6"	5.0	22.7	250	15208	531	26
1503-02	48	0-6"	4.4	15.4	168	2782	249	18
1505-04	49	0-6"	3.3	7.9	142	1094	235	19
1504-03	50	0-6"	2.5	19.5	38	342	358	20
1504-01	51	0-6"	5.3	66.4	272	3124	399	22
1504-02	52	0-6"	3.7	11.5	152	3602	315	23
1507-03	53	0-6"	4.0	20.0	134	2212	219	29
1507-04	54	0-6"	4.0	19.7	132	2417	182	13
1507-02	55	0-6"	2.6	30.2	62	4150	221	15
1507-01	56	0-6"	3.8	10.0	184	1619	465	19
1701-01	57	0-6"	4.0	7.5	172	1345	262	24
1701-05	58	0-6"	5.7	39.8	80	2143	89	18
1707-06	59	0-6"	5.4	8.3	116	1300	253	24
1702-01	60	0-6"	4.8	18.0	186	4856	315	26
1702-03	61	0-6"	4.2	10.9	120	1072	219	17

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH(1:1)	Bi-carb P (PP2M)	K	Lbs./1000 Tons Ca	Lbs./1000 Tons Mg	Na
1703-01-01	62	0-6"	3.9	10.8	130	1368	132	13
1703-01-02	63	0-6"	4.2	17.3	218	502	98	24
805A-NW	73	0-6"	3.6	24.5	158	6270	331	25
804	74	0-6"	3.4	14.0	264	1459	353	25
T. Hill	75	0-6"	4.9	18.1	198	1231	205	19
1204-N	76	0-6"	5.5	25.0	202	4720	151	16
1204-SW	77	0-6"	4.1	26.2	216	2918	208	20
1204-E	78	0-6"	3.4	28.0	230	3032	267	20
1205-01	79	0-6"	6.2	15.4	266	4127	463	25
1205-05	80	0-6"	2.8	35.7	132	1870	458	17
1505-01	81	0-6"	2.8	47.8	80	1049	100	17
1505-05	82	0-6"	6.7	32.1	224	7022	333	20
1505-07	83	0-6"	4.3	35.6	156	5039	176	16
1205-07	84	0-6"	6.1		320	5449	456	18
1303-01	85	0-6"	5.2	31.0	188	4172	536	20

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH(1:1)	Bi-carb P (PP2M)	K	Lbs./1000 Tons Ca	Lbs./1000 Tons Mg	Na
1303-07	86	0-6"	6.0	73.2	284	17488	365	25
1303-04	87	0-6"	6.0	42.1	340	3534	420	23
1705B-02	88	0-6"	4.1	16.3	272	1778	317	20
1705B-03	89	0-6"	4.4	17.1	2.8	2326	219	20
1705A-02	90	0-6"	4.6	21.1	232	1550	253	18
1705A-04	91	0-6"	3.9	10.7	172	1550	203	16
No Tag		0-6"	2.9	12.0	58	1322	166	14

TABLE _____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH (1:1)	KCl Al (meq/100 g)	PPM			
					Zn	Cu	Mn	Fe
601A-03	1	0-6"	6.0	.03	3.6	1.3	72	272
602A-04	2	0-6"	6.2	.01	9.7	0.8	54	292
602A-07	3	0-6"	4.7	2.45	0.8	0.5	3	48
501-02	4	0-6"	4.7	1.66	4.6	1.0	126	244
501-04	5	0-6"	3.5	1.02	6.1	0.9	502	1232
501-07	6	0-6"	4.2	.59	4.7	1.4	185	361
503	7	0-6"	4.3	1.09	8.2	1.0	134	316
503-N	8	0-6"	5.2	.03	7.2	0.8	166	154
503	9	0-6"	4.3	.89	2.7	0.7	72	128
503-S	10	0-6"	4.4	.64	6.8	0.6	195	193
EWFS	11	0-6"	4.6	.02	5.0	0.7	112	142
802	12	0-6"	3.8	.61	3.8	0.5	68	159
802	13	0-6"	4.2	.67	3.1	0.4	21	99
803-N	14	0-6"	3.2	3.52	10.7	0.8	235	403

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH (1:1)	KCl Al (meq/100 g)	PPM Zn	Cu	Mn	Fe
803-C	15	0-6"	4.3	1.20	4.3	0.9	194	249
1003B	16	0-6"	6.0	.01	3.7	0.6	187	158
1201-NW	17	0-6"	5.5	.00	3.4	0.6	15	229
1201-SW	18	0-6"	6.0	.02	2.0	0.7	38	83
1203-SW	19	0-6"	4.5	.43	2.3	0.5	56	269
1203-NW	20	0-6"	4.8	.07	5.2	0.6	44	320
1203B-01	21	0-6"	3.4	1.81	3.0	0.5	25	238
1302B-02	23	0-6"	5.4	.01	2.9	0.6	31	83
1302A-01	24	0-6"	4.7	.04	7.9	0.8	24	115
1302A-02	25	0-6"	4.4	1.42	1.7	0.4	24	42
1304-N	26	0-6"	4.8	.04	21.0	0.6	21	175
1304-CE	27	0-6"	4.3	.12	11.8	0.7	44	211
1304-SW	28	0-6"	5.0	.17	2.0	0.3	20	28
1304-SE	29	0-6"	6.4	.01	3.8	.6	65	304

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH (1:1)	KCl Al (meq/100 g)	PPM			
					Zn	Cu	Mn	Fe
1509-02	30	0-6"	2.4	3.69	7.4	.8	29	581
1509-03	31	0-6"	5.1	.06	4.4	.7	37	100
1509-01	32	0-6"	2.5	4.73	5.6	.7	46	630
1508-02	33	0-6"	6.1	.03	3.4	.6	6	115
1508-04	34	0-6"	4.9	.02	4.0	.7	8	164
1508-03	35	0-6"	5.9	.01	3.2	.7	25	124
1508-05	36	0-6"	4.5	.01	7.0	.8	46	302
1506-02	37	0-6"	2.9	1.45	4.1	.7	76	287
1506-03	38	0-6"	3.0	3.39	5.7	.9	114	426
1505-02	39	0-6"	3.3	4.33	3.0	.8	30	274
1505-01	40	0-6"	3.8	1.93	2.1	.5	11	121
1704-01	41	0-6"	4.8	.07	3.9	.8	30	151
1704-03	42	0-6"	4.1	1.66	2.4	.9	47	223
1706-01	43	0-6"	2.9	1.63	2.0	.5	8	237

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH (1:1)	KCl Al (meq/100 g)	PPM			
					Zn	Cu	Mn	Fe
1706-02	44	0-6"	5.2	.32	2.7	.7	29	204
1503-05	45	0-6"	4.3	.00	5.2	1.1	141	248
1503-06	46	0-6"	5.0	.02	5.0	1.4	71	264
1503-02	48	0-6"	4.4	.47	2.5	.5	26	108
1504-04	49	0-6"	3.3	3.55	2.4	.5	23	121
1504-03	50	0-6"	2.5	5.73	4.4	.5	37	349
1504-01	51	0-6"	5.3	.03	2.8	.6	21	82
1504-02	52	0-6"	3.7	2.72	7.4	.7	39	130
1507-03	53	0-6"	4.0	.82	2.5	.8	7	141
1507-04	54	0-6"	4.0	1.66	2.3	.4	15	112
1507-02	55	0-6"	2.6	4.55	2.9	.7	19	528
1507-01	56	0-6"	3.8	2.01	2.4	.6	28	62
1701-01	57	0-6"	4.0	1.29	2.4	.5	18	61
1701-05	58	0-6"	5.7	.04	1.8	.2	6	67

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH (1:1)	KCl Al (meq/100 g)	PPM			
					Zn	Cu	Mn	Fe
1701-06	59	0-6"	5.4	.07	4.9	.4	16	43
1702-01	60	0-6"	4.8	.02	3.7	.6	22	86
1702-03	61	0-6"	4.2	1.13	2.0	.5	9	81
1703-01-01	62	0-6"	3.9	2.78	2.0	.5	8	66
1703-01-02	63	0-6"	4.2	1.72	6.6	.5	9	208
805A-NW	73	0-6"	3.6	1.69	5.8	.8	74	203
804	74	0-6"	3.4	.81	3.5	.7	92	185
T. Hill	75	0-6"	4.9	.08	1.2	.4	19	189
1204-N	76	0-6"	5.5	.02	2.7	.5	17	210
1204-SW	77	0-6"	4.1	.26	3.0	.5	29	158
1204-E	78	0-6"	3.4	.70	3.6	.5	63	267
1205-01	79	0-6'	6.2	.04	2.2	.6	14	24
1205-05	80	0-6"	2.8	3.24	5.2	.7	58	487
1501- 01	81	0-6"	2.8	2.57	2.3	.5	16	398

TABLE ____

NUTRIENT STATUS REPORT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	pH (1:1)	KCl Al (meq/100 g)	PPM			
					Zn	Cu	Mn	Fe
1501-05	82	0-6"	6.7	.02	7.0	.7	56	114
1501-07	83	0-6"	4.3	.08	4.1	.6	35	131
1205-07	84	0-6"	6.1	.00	7.2	.6	20	58
1303-01	85	0-6"	5.2	.02	3.3	.5	32	38
1303-07	86	0-6"	6.0	.02	59.2	3.8	39	131
1303-04	87	0-6"	6.0	.03	3.3	.5	17	16
1705B-02	88	0-6"	4.1	1.07	2.8	.6	7	65
1705B-03	89	0-6"	4.4	.61	8.5	.5	15	62
1705A-02	90	0-6"	4.6	.67	9.7	.5	24	79
1705A-04	91	0-6"	3.9	1.08	3.7	.7	27	99
No Tag		0-6"	2.9	2.74	3.2	.6	18	223

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
501-02	1	0-6"	4.7	None	10YR6/4	.0168	.53	.46	.07	
0501-0402	2	0-6"	4.9	Slight	7.5YR7/4	.4066	12.71	5.05	7.66	
0501-07	3	0-6"	6.2	Slight	10YR6/4	.0233	.73	7.20		6.47
503-N	4	0-6"	7.2	Moderate	2.5Y6/2	.0509	1.59	16.95		15.36
503-SC	5	0-6"	7.2	Moderate	2.5Y6/4	.0534	1.67	28.64		26.97
0503-SE	6	0-6"	7.1	Slight	2.Y6/2	.0872	2.73	13.93		11.20
802-N	7	0-6"	6.2	None	5Y6/4	.0494	1.54	4.44		2.90
802-E	8	0-6"	5.7	Slight	10YR6/8	.0602	1.88	1.99		.11
0803-N	9	0-6"	4.8	Slight	10YR6/4	.0501	1.57	1.84		.27
803-C	10	0-6"	4.7	Slight	10YR6/3	.0208	.65	.46	.19	
0803-S	11	0-6"	5.5	None	10YR6/4	.0396	1.24	1.41		.17
0804	12	0-6"	6.8	Slight	2.5Y6/4	.0386	1.21	5.66		4.45
805-A	13	0-6"	6.9	Moderate	2.5Y6/4	.0549	1.72	20.74		19.02
1003	14	0-6"	6.2	Slight	2.5Y6/4	.0440	1.38	4.24		2.86

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
							Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1005-E	15	0-6"	3.9	None	5y5/3	.2213	6.92	-1.89	8.81	
1706-01-02	16	0-6"	4.7	Slight	2.5Y6/4	.1076	3.36	-2.83	6.19	
1706-02	17	0-6"	7.2	Slight	2.5Y6/2	.0106	.33	12.25		11.92
1704-01	18	0-6"	6.1	Slight	2.5Y6/4	.0196	.61	4.71		4.10
1704-03	19	0-6"	5.9	None	2.5Y6/4	.0144	.45	5.66		5.21
1701-01	20	0-6"	5.7	None	2.5Y6/4	.0267	.83	1.41		.58
1701-05	21	0-6"	7.5	Slight	2.5Y6/4	.0158	.49	7.54		7.05
1701-06	22	0-6"	6.6	Slight	2.5Y6/2	.0087	.27	3.30		3.03
1702-03	23	0-6"	6.7	Moderate	.25Y6/4	.0120	.38	6.88		6.50
1702-01	24	0-6"	7.2	Moderate	2.5Y6/4	.0170	.53	10.76		10.23
1705-A-02	25	0-6"	6.3	Slight	2.5Y6/4	.0104	.33	3.89		3.56
1705-A-04	26	0-6"	5.5	None	2.5Y6/2	.0393	1.23	2.54		1.31
1705-A-0201	27	0-6"	7.3	Moderate	2.5Y6/2	.0244	.76	11.06		10.30
	28	0-6"	7.1	Slight	2.5Y6/4		8.07			

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1201	29	0-6"	7.2	Slight	2.5Y6/2	.0818	2.56	11.66		9.10
1201-SW	30	0-6"	7.1	Slight	2.5Y6/4	.0498	1.56	14.84		13.28
1201-E	31	0-6"	5.9	Slight	2.5Y6/4	.1609	5.03	6.88		1.85
1201-Center	32	0-6"	4.3	None	2.5Y6/2	.2142	6.69	1.50	5.19	
1203-SW	33	0-6"	7.0	Slight	5Y6/4	.0450	1.41	10.47		9.06
1203-NW	34	0-6"	6.2	Slight	2.5Y6/4	.1175	3.67	11.36		7.69
1203-NE	35	0-6"	5.7	Slight	2.5Y6/4	.0382	1.19	3.69		2.50
1203-Center	36	0-6"	6.1	Slight	5Y5/3	.0438	1.37	5.54		4.17
1304	37	0-6"	6.1	Slight	5Y5/3	.0282	.88	6.00		5.12
1304-CE	38	0-6"	5.9	Slight	2.5Y6/2	.0996	3.11	5.08		1.97
1304-SE	39	0-6"	6.9	Moderate	2.5Y6/2	.2439	7.62	18.01		10.39
1304-SC	40	0-6"	6.5	Slight	2.5Y5/2	.5969	18.65	18.93		.28
1304-SW	41	0-6"	7.2	Slight	2.5Y6/4	.0360	1.13	10.16		9.03
1304-CW	42	0-6"	6.4	Slight	2.5Y6/4	.3128	9.78	11.54		1.76

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

							$CaCO_3$ Equivalent Tons/1000 Tons Material			
Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1302-A-0102	43	0-6"	7.0	Moderate	5Y5/4	.0564	1.76	19.85		18.09
13020-02-03	44	0-6"	6.8	Slight	5Y5/3	.0120	.38	4.16		3.78
1302-B-01	45	0-6"	6.6	Moderate	2.5Y6/4	.0877	2.74	17.08		14.34
1302-B-02	46	0-6"	5.7	None	2.5Y7/4	.0141	.44	1.39		.95
	47	0-6"	5.7	Slight	5Y5/3	.0347	1.08	4.36		3.28
1204-East	48	0-6"	5.0	Slight	2.5Y5/2	.0641	2.00	2.86		.86
1204-SW	49	0-6"	6.4	Slight	5Y5/3	.0638	1.99	7.67		5.68
1501-01	50	0-6"	4.0	None	2.5Y6/4	.1458	4.56	-3.16	7.72	
1501-05	51	0-6"	5.2	Slight	2.5Y6/4	.0181	.57	2.77		2.20
1501-07	52	0-6"	4.4	None	2.5Y6/4	.1250	3.91	-3.10	7.01	
1303-04	53	0-6"	7.4	Slight	2.5Y5/2	.0109	.34	13.85		13.51
1303-07	54	0-6"	7.0	Moderate	2.5Y5/2	.0475	1.48	18.50		17.02
1303-01	55	0-6"	7.4	Slight	2.5Y6/2	.0087	.27	8.42		8.15
1205-01	56	0-6"	7.5	Moderate	5Y5/3	.0259	.81	17.00		16.19

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1205-03	57	0-6"	7.2	Slight	2.5Y6/4	.0178	.56	8.73		8.17
1205-07	58	0-6"	6.7	Slight	5Y5/3	.0335	1.05	8.27		7.22
1509-08	59	0-6"	6.6	Moderate	2.5Y6/4	.0382	1.19	11.29		10.10
1509-03	60	0-6"	6.0	Moderate	2.5Y6/2	.0271	6.47	11.29		4.82
1509-02	61	0-6"	3.6	Slight	2.5Y6/2	.1942	6.07	-4.84	10.91	
1509-01	62	0-6"	4.5	None	2.5Y5/2	.2197	6.87	.23	6.64	
1508-04	63	0-6"	6.5	Moderate	2.5Y6/4	.2086	6.52	16.94		10.42
1508-04	64	0-6"	6.5	Slight	2.5Y5/2	.0863	2.70	21.89		19.19
1508-05	65	0-6"	6.8	Moderate	2.5Y6/4	.1888	5.90	24.19		18.29
1508-03	66	0-6"	6.8	Moderate	2.5Y5/2	.1083	3.38	8.99		5.61
1506-03	67	0-6"	5.9	Slight	2.5Y5/2	.8822	27.57	22.35	5.22	
1503-03	68	0-6"	4.7	Slight	2.5Y6/4	.2893	9.04	3.46	5.58	
1505-02-East	69	0-6"	3.9	None	2.5Y5/2	.2006	6.27	6.22	.05	
1507-0102	70	0-6"	5.4	Slight	2.5Y6/4	.0272	.85	2.53		1.68

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREAS

Divide Section - Tennessee Tombigbee Waterway

Disposal Area	Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1507-03	71	0-6"	4.6	None	2.5Y5/2	.0818	2.56	-.91	3.47	
1507-04	72	0-6"	4.5	None	2.5Y6/2	.0536	1.68	-1.21	2.89	
1701-07	73	0-6"	6.8	Moderate	2.5Y6/4	.1091	3.41	17.86		14.45
1205-05	74	0-6"	4.3	Slight	2.5Y5/2	.1863	5.82	-.76	6.58	
1507-02-02	75	0-6"	4.1	None	2.5Y5/2	.3561	11.13	-5.30	16.43	

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREA 1302 B

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1	0-4"	3.30	Slight	2.5Y6/2	.1189	3.72	1.17	2.55	
2	4-8"	2.68	None	2.5Y5/2	.1806	5.64	-2.13	7.95	
3	0-4"	5.86	None	2.5Y5/4	.0180	.56	2.77		2.21
4	4-8"	3.86	None	2.5Y5/4	.0215	.67	- .92	1.59	
5	0-1"	3.53	None	2.5Y5/4	.1949	6.09	- .46	6.55	

TABLE 16

NUTRIENT STATUS REPORT - DISPOSAL AREA 1302 B

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	Bi-carb P (PP2M)	Lbs./1000 Tons			
				K	Ca	Mg	Na
1	0-4"	3.04	57	88	2987	226	36
2	4-8"	2.67	35	66	3671	237	30
3	0-4"	5.24	52	266	4309	472	52
4	4-8"	3.80	21	158	1208	351	46
5	0-1"	3.33	103	102	4674	253	28

TABLE 14

NUTRIENT STATUS REPORT - DISPOSAL AREA 1302 B

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	pH (1:1)	KCl Al (meq/100g.)	PPM Mn	Cu	Zn	Fe
1	0–4"	3.04	3.5	37	.7	2.8	239
2	4–8"	2.67	6.5	49	.8	2.2	274
3	0–4"	5.24	0.0	35	1.0	2.9	119
4	4–8"	3.80	2.6	32	.8	1.3	124
5	0–1"	3.33	1.7	53	.8	5.8	528

TABLE ____

ACID-BASE ACCOUNT OF DISPOSAL AREA 1508

Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material			
						Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1	0-6"	6.8	Moderate	2.5Y6/4	.1303	4.07	16.16		12.09
2	0-6"	6.6	Moderate	2.5Y6/4	.1424	4.45	10.62		6.17
3	0-6"	6.1	Slight	2.5Y6/4	.1554	4.86	2.48	2.38	
4	0-6"	6.3	Slight	2.5Y6/4	.0784	2.45	6.81		4.36
5	0-6"	6.4	Moderate	2.5Y6/4	.2496	7.80	13.47		5.67
6	0-6"	6.6	Moderate	2.5Y6/4	.1704	5.33	21.68		16.35

APPENDIX F

Relationship Between Sodium Bicarbonate Extractable

Phosphorus, Double Acid Extractable Phosphorus, and Iron Concentrations

Double acid extractable phosphorus was initially determined on 60 mesh samples from cores U894A, 8895, U895A, and U896. Many of the samples analyzed did not develop the characteristic yellow color associated with the double acid test for phosphorus. Some samples developed various shades of green, while others became cloudy. After absorbance at 420 nanometers was read from the spectrophotometer, samples were set aside and examined later for cloudiness or a precipitate. Those samples which were visibly cloudy at the time of analysis were termed "very cloudy" and those in which cloudiness was only apparent after a period of time were simply termed "cloudy".

Samples were then analyzed for double acid extractable iron. A very high correlation was noted between high iron concentrations and failure of the double acid test (see tables on following pages). Due to the high number of samples for which a double acid phosphorus determination could not be made, use of this test was discontinued. Apparently high concentrations of mobile iron and possibly other elements arising from the reduced condition of the environment cause an interference with this test. This same phenomenon has also been noted in swamp-bottom sediments in west Tennessee (Mills, Ammons, Shelton, 1981).

Relationship between Sodium Bicarbonate Extractable Phosphorus, Double Acid Phosphorus, and Iron Concentrations.

Tennessee Tombigbee Waterway

Core U894A

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
1	0.0	Low	68	High	348
2	0.0	Low	81	V. High	343
3	0.0	Low	74	High	324
4	8.5	Low	74	High	268
5	3.0	Low	58	High	317
6	0.0	Low	V. Cloudy	----	>500
7	4.5	Low	60	High	194
8	3.5	Low	60	High	207
9	3.5	Low	60	High	178
10	16.5	Medium	63	High	200
11	3.5	Low	58	High	161
12	3.0	Low	79	High	202
13	7.0	Low	74	High	208
14	1.0	Low	80	V. High	237
15	4.5	Low	88	V. High	248
16	15.0	Medium	480	V. High	178
17	8.0	Low	108	V. High	303
18	16.0	Medium	115	V. High	232
19	1.0	Low	V. Cloudy	----	>500
20	4.5	Low	65	High	190

Core U894A (continued)

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
21	3.5	Low	Cloudy	----	362
22	5.5	Low	Cloudy	----	386
23	2.5	Low	Green	----	>500
24	8.5	Low	438	V. High	393
25	6.0	Low	Green	----	>500
26	6.0	Low	385	V. High	>500
27	20.0	Medium	363	V. High	>500
28	5.5	Low	Cloudy	----	>500
29	3.5	Low	Cloudy	----	>500
30	13.5	Low	Cloudy	----	435
31	----	----	----	----	----
32	----	----	----	----	----
33	4.5	Low	Cloudy	----	----
34	20.0	Medium	165	V. High	389
35	25.0	High	118	V. High	282
36	10.0	Low	Cloudy	----	448
37	13.5	Medium	181	V. High	344
38	13.0	Medium	V. Cloudy	----	447
39	11.5	Medium	Cloudy	----	368
40	8.5	Low	68	High	215
41	6.0	Low	65	High	242
42	1.0	Low	V. Cloudy	----	474
43	4.0	Low	V. Cloudy	----	>500
44	10.0	Low	V. Cloudy	----	>500

Relationship between Sodium Bicarbonate Extractable Phosphorus, Double Acid Phosphorus, and Iron Concentrations.

Tennessee Tombigbee Waterway

Core U895

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
1	140.0	V. High	182	V. High	154
2	134.0	V. High	192	V. High	255
3	37.0	V. High	92	V. High	302
4	16.0	Medium	34	Medium	103
5	25.5	High	55	High	164
6	14.0	Medium	24	Low	84
7	19.5	Medium	50	Medium	200
8	23.0	High	48	Medium	187
9	8.0	Low	Cloudy	----	418
10	6.5	Low	Cloudy	----	376
11	9.3	Low	154	V. High	344
12	7.0	Low	Cloudy	----	394
13	6.0	Low	100	V. High	352
14	5.0	Low	V. Cloudy	----	452
15	6.5	Low	90	V. High	295
16	4.7	Low	95	V. High	270
17	5.5	Low	97	V. High	324
18	5.0	Low	92	V. High	495
19	4.7	Low	83	V. High	389
20	5.0	Low	90	V. High	217
21	9.0	Low	121	V. High	222

Core U895 (continued)

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
22	11.2	Medium	176	V. High	353
23	13.5	Medium	Green	----	473
24	6.5	Low	V. Cloudy	----	>500
25	6.0	Low	V. Cloudy	----	>500
26	17.5	Medium	568	V. High	283
27	----	----	----	----	----
28	6.5	Low	Cloudy	----	422
29	19.5	Medium	Green	----	225
30	12.0	Medium	158	V. High	263
31	10.0	Low	V. CLoudy	----	444
32	4.7	Low	V. Cloudy	----	473
33	12.2	Medium	256	V. High	493
34	19.5	Medium	Green	----	286
35	25.5	High	V. Cloudy	----	>500
36	12.0	Medium	416	V. High	282
37	17.5	Medium	376	V. High	214
38	28.0	High	272	V. High	342
39	9.0	Low	67	High	269
40	15.7	Medium	176	V. High	315

Core U895 (continued)

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
41	----	----	----	----	----
42	----	----	----	----	----
43	12.0	Medium	V. Cloudy	----	466

Relationship between Sodium Bicarbonate Extractable Phosphorus, Double Acid Phosphorus, and Iron Concentrations.

Tennessee Tombigbee Waterway

Core U895A

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
1	13.0	Medium	138	V. High	68
2	----	----	----	----	----
3	18.0	Medium	70	High	201
4	17.5	Medium	46	Medium	135
5	12.5	Medium	79	High	280
6	----	----	----	----	----
7	5.5	Low	Cloudy	----	376
8	12.0	Medium	Cloudy	----	361
9	18.0	Medium	Cloudy	----	242
10	31.0	V. High	Cloudy	----	310
11	62.5	V. High	1092	V. High	31
12	17.5	Medium	112	V. High	238
13	12.0	Medium	125	V. High	282

Relationship between Sodium Bicarbonate Extractable Phosphorus, Double Acid Phosphorus, and Iron Concentrations.

Tennessee Tombigbee Waterway

Core U896

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
1	25.0	High	100	V. High	383
2	----	----	----	----	----
3	13.5	Medium	195	V. High	135
4	16.0	Medium	212	V. High	103
5	64.0	V. High	133	V. High	350
6	21.0	High	V. Cloudy	----	497
7	15.0	Medium	66	High	302
8	20.0	Medium	V. Cloudy	----	>500
9	31.0	V. High	V. Cloudy	----	486
10	18.5	Medium	72	High	340
11	20.0	Medium	Cloudy	----	383
12	18.5	Medium	59	High	239
13	18.5	Medium	52	High	231
14 AL	16.0	Medium	50	Medium	161
14 EU	18.5	Medium	V. Cloudy	----	490
15	20.0	Medium	V. Cloudy	----	>500
16	22.0	High	79	High	217
17	25.0	High	V. Cloudy	----	>500
18	24.0	High	135	V. High	421
19	25.5	High	129	V. High	320
20	25.5	High	104	V. High	303

Core U896 (continued)

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
21	21.0	High	90	V. High	174
22	24.0	High	118	V. High	224
23	34.0	V. High	101	V. High	172
24	20.0	Medium	76	High	162
25	20.0	Medium	95	V. High	219
26	12.5	Medium	75	High	115
27	10.0	Low	Cloudy	----	434
28	12.5	Medium	Cloudy	----	393
29	11.0	Medium	Cloudy	----	484
30	22.5	High	Green	----	>500
31	40.5	V. High	333	V. High	454
32	12.0	Medium	V. Cloudy	----	>500
33	10.5	Medium	V. Cloudy	----	>500
34	30.0	High	231	V. High	483
35	35.5	V. High	360	V. High	>500
36	24.0	High	255	V. High	396
37	18.0	Medium	Green	----	>500
38	59.0	V. High	Green	----	156
39	15.0	Medium	Cloudy Green	----	>500

Core U896 (continued)

Sample Number	Bicarb P pp2m	Status	Double acid P (lbs/1000T)	Status	Iron ppm
40	17.5	Medium	246	V. High	>500
41	21.0	High	V. Cloudy	----	>500
42	19.5	Medium	Cloudy	----	412
43	23.0	High	135	V. High	300
44	31.0	V. High	312	V. High	307

APPENDIX G

Vegetation - Evaluations and Plant Species

APPENDIX G

List of Plants Encountered on Disposal Areas of the Divide Section

SCIENTIFIC NAME	COMMON NAME
Aira elegans	Hairgrass
Ambrosia artemisiifolia	Common ragweed
Andropogon virginicus	Broomsedge
Bromus tectorum	Cheat
Cassia faciculata	Partridge pea
Chenopodium album	Lambsquarter
Chloris spp	Fingergrass
Conyza spp	Marestail
Cynodon dactylon	Bermudagrass
Cyperus esculentus	Yellow nutsedge
Dactylis glomerata	Orchardgrass
Digitaria spp	Crabgrass
Drymaria cordata	Heartleaf drymary
Eragrostis curvula	Weeping lovegrass
Eragrostis lehmanniana	Lehman's lovegrass
Erechtites hieracifolia	Erechtites
Festuca arundinacea	Tall fescue
Gnaphalium purpureum	Cudweed
Hordeum pussilum	Little barley
Lactuca scariola	Wild lettuce
Lepidium virginicum	Virginia pepperweed

SCIENTIFIC NAME	COMMON NAME
Lespedeza bicolor	Bicolor lespedeza
Lespedeza cuneata	Sericea lespedeza
Lespedeza striata	Common lespedeza
Lolium italica	Annual Ryegrass
Oenothera laciniata	Cutleaf evening primrose
Panicum clandestinium	Deerstongue
Panicum dichotomiflorum	Fall panic
Panicum ramosum	Millet
Panicum virgatum	Switchgrass
Paspalum notatum	Bahiagrass
Phytolacca americana	Pokeweed
Polygonum pennsylvanicum	Smartweed
Rumex acestosella	Broadleaf dock
Rumex crispus	Curly leaf dock
Secale cereale	Rye
Setaria spp	Foxtails (annual grasses)
Solidago spp	Goldenrod
Trifolium incarnatum	Crimson clover
Trifolium pratense	Red clover
Trifolium repens	White clover
Triticum aestivum	Wheat
Vicia villosa	Hairy vetch
Xanthium pennsylvanicum	Cocklebur

APPENDIX G

COMMON NAME	SCIENTIFIC NAME
Annual ryegrass	Lolium italica
Bahiagrass	Paspalum notatum
Bermudagrass	Cynodon dactylon
Bicolor lespedeza	Lespedeza bicolor
Broadleaf dock	Rumex acetosella
Broomsedge	Andropogon virginicus
Cheat	Bromus tectorum
Cocklebur	Xanthium pennsylvanicum
Common lespedeza	Lespedeza striata
Common ragweed	Ambrosia artemisiifolia
Crabgrass	Digitaria spp
Crimson clover	Trifolium incarnatum
Cudweed	Gnaphalium purpureum
Curly leaf dock	Rumex crispus
Cutleaf evening primrose	Oenothera laciniata
Deerstongue	Panicum clandestinium
Erechtites	Erechtites hieracifolia
Fall panic	Panicum dichotomiflorum
Fingergrass	Chloris spp
Foxtail grasses	Setaria spp
Goldenrod	Solidago spp
Hairgrass	Aira elegans

COMMON NAME	SCIENTIFIC NAME
Hairy vetch	_Vicia villosa_
Heartleaf drymary	_Drymaria cordata_
Lambsquarter	_Chenopodium album_
Lehman's lovegrass	_Eragrostis lehmanniana_
Little barley	_Hordeum pussilum_
Marestail	_Conyza_ spp
Millet	_Panicum ramosum_
Orchardgrass	_Dactylis glomerata_
Partridge pea	_Cassia faciculata_
Pokeweed	_Phytolacca americana_
Red clover	_Trifolium pratense_
Rye	_Secale cereale_
Sericea lespedeza	_Lespedeza cuneata_
Smartweed	_Polygonum pennsylvanicum_
Switchgrass	_Panicum virgatum_
Tall fescue	_Festuca arundinacea_
Weeping lovegrass	_Eragrostis curvula_
Wheat	_Triticum aestivum_
White clover	_Trifolium repens_
Wild lettuce	_Lactuca scariola_
Yellow nutsedge	_Cyperus esculentus_
Virginia pepperweed	_Lepidium virginicum_

VEGETATION EVALUATION - DA 1504

All Plant Growth; Reported as Per Cent of Ground
Covered and Rank Order of Growth
Relative to Lime Rates

Evaluation Date: December 7, 1982
Personnel: Glenn Davis

	LIMING RATE (Tons/1000 Tons)										
Repli-	4		8		16		32		64		Mean
cation	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%
I	10	5	20	4	50	3	75	2	90	1	49
II	25	4	50	3	5	5	95	1	80	2	61
III	2	5	5	4	10	3	60	2	80	1	31
IV	20	4	15	5	40	3	90	1	60	2	45
Mean	14		23		39		80		78		

Notes: The overall plot was evaluated in each case.
Wheat was the primary species in 11 of the 20 plots.
A mixture of species was present in 12 of the 20.
Weeping lovegrass was the primary species in one plot.
Bermudagrass was dominant in two plots.
Wheat plants volunteered from seed in the mulch applied to the plots in August, 1981.

APPENDIX G

Reliming[1] and Reseeding[2] of Demonstration Plots in DA 1504
Plots Listed Below Received 3 Tons/Acre on July 13, 1982.

Replication	------------- Original Liming, Rate, 1981 ----------				
I	#9-12	#13-16	----	--(3)	----
II	#29-32	#37-40	----	----	----
III	#41-44	#45-48	#49-52	----	----
IV	#73-76	#77-80	#61-64	----	----

[1]Lime was applied to the plot surface at a rate of 3 tons per acre on the southern one-half of each plot listed above. One ton per acre was applied to the southern one-half of each plot in the demonstration but not listed above. Four tons per acre of straw mulch were applied over the 3 ton lime rate plots. The one ton per acre plots were not mulched.

[2]All plots in the demonstration were overseeded August 13, 1982 with the same seeding mixture used in the original seeding in 1981, except crimson clover was replaced with sericea lespedeza in the mix including tall fescue.

[3]Mulch was applied to intermittent areas of bare soil surface in the demonstration area.

APPENDIX G

OBSERVATIONS ON VEGETATION AND RECOMMENDATIONS

Areas Visited - Tennessee Tombigbee

Area	Date	Personnel
DA 1509	July 23, 1981	G. Davis J. Linkinhoker T. Ammons F. Cope

Area of 72 acres seeded in 1980. Heavily terraced area. Area was projected by Corps to be revegetated via maintenance contract by complete tillage and seeding.

South Portion by Entrance Gate

Bare ground to sparse (20% ground cover) to moderate (50%) cover. A few heavily vegetated patches. The most vigorous plants were sericea. The second most vigorous were weeping lovegrass. There were a few bahiagrass plants. (Pensacola bahigrass was seeded in the mix).

Recommendation by Glenn Davis to Corps personnel at the Site

Strips of 30 feet or more of width with 50% or more of ground cover by vegetation should be left undisturbed, that is, they should not be tilled or damaged when zones with less ground cover are reseeded.

DA 1509 Mid Section (Moving Northward)

Heavily cover of dried rye stubble that had been mowed in June. Tall fescue six inches high and annual ryegrass was abundant. Observation: No modifications needed.

DA 1509 - Far North Portion

Two major blown out structures needs total reshaping as planned by the Corps.

APPENDIX G

OBSERVATIONS ON VEGETATION AND RECOMMENDATIONS

Other Disposal Areas

Area	Date	Personnel
DA 1309 B	July 22, 1981	G. Davis J. Linkinhoker T. Ammons F. Cope D. McMillen

OBSERVATIONS ON DA 1302 B

Eastern 1/4

Approximately 25% of the area (the eastern 25%) was sparsely vegetated (25 - 30% ground cover) with sericea lespedeza, bermudagrass, and marestail (Conyza spp) with occasional annual ryegrass and weeping lovegrass plants. The maximum depth of grass root penetration was two inches, except for scattered roots that penetrated deeper. These grass roots were blunt and bulbous at the tips. The deformed roots were 1/4 to 1 inch in length. Ammnons took a soil sample from this portion of 1302B.

Western 3/4

The western 75% of the area of 1302 B was heavily vegetated. This portion of 1302 B has "topsoiling" of a reddish soil. Ammons took soil samples and field tested pH. At 0-1 inch in depth (in the topsoiling) the pH was 7.0. At 4-10 inch depth, pH was 5.0.

AD-A132 615 SOIL AND VEGETATION PROJECT A DETAILED STUDY OF FIVE OVERBURDEN CORES AND..(U) TENNESSEE TECHNOLOGICAL UNIV COOKEVILLE DEPT OF PLANT AND SOI.. J T AMMONS ET AL.

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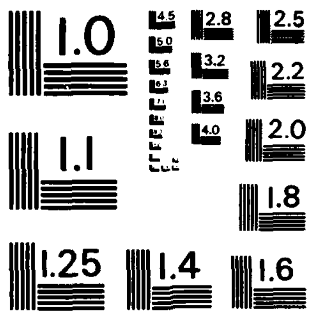

MICROCOPY RESOLUTION TEST CHART
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A P P E N D I X H

RHIZOBIA VIABILITY ON INOCULATED LESPEDEZA SEED

RHIZOBIA VIABILITY ON INOCULATED LESPEDEZA SEED

Prepared for

Department of the Army
Nashville District, Corps of Engineers

Contract No. DACW62-81-C-0205

Modification No. P00001

Larry D. Smith

Plant & Soil Science Department

Tennessee Technological University

August 1982

RHIZOBIA VIABILITY ON INOCULATED LESPEDEZA SEED

The viability of Rhizobia on inoculated Lespedeza seed was determined following storage at three temperatures (40, 60, and 70 F) for five time periods (0, 3, 7, 14, and 28 days). Two batches of inoculated seed were studied. They were delivered to Tennessee Technological University on May 9 and June 17, 1982. The inoculated seed were collected by Corps personnel soon after inoculation and transported in double plastic bags held on ice to maintain viability.

Seed batches were thoroughly mixed to obtain a uniform distribution of seed and inoculum. The batches were divided into three equal portions and placed in double plastic bags to reduce moisture loss. One portion was placed in each of three constant temperature incubators (40, 60, and 70F). Immediately and after 3, 7, 14, and 28 days of storage samples from the seeds in each of the three temperatures were examined to determine the number of viable Rhizobia present on the seed. Loose inoculum in the bottom of the bags was not examined.

Viability of Rhizobia on one gram of inoculated seed was determined. One gram of seed (approx. 685 seed) was taken at random from the sample bags and placed in 100 ml sterile distilled water. This was shaken on an orbital shaker for 20 minutes to disperse the Rhizobia in a water suspension. The water suspension was used in a serial dilution series of sterile distilled water. Dilutions of 10^{-3}, 10^{-4}, 10^{-5}, and 10^{-6} were made. One-tenth ml of each dilution was placed on each of three Petri plates containing yeast extract mannitol agar (UMA) with Congo red. The plates were incubated at 30C for 5-7 days to allow

colonies to develop. Congo red in the agar is helpful in distinguishing Rhizobia from contaminate bacteria. The number of colonies on each of the plates from each of the dilutions was counted. Determinations of the number of viable Rhizobia per gram of seed were made.

Results: The numbers of viable Rhizobia in the two batches (5/9 and 6/17) showed considerable variation in the initial determination (day 0) with 215×10^5 and 528×10^5 viable Rhizobia per gram of inoculated seed respectively (Figures 1 and 3). This indicates tremendous variation in the level of viable Rhizobia in the inoculant or in inoculation technique.

The greatest reduction in viability occurred in the first 7 days of storage (Figures 1 and 3). This was true for all storage temperatures. The 6/17 batch which had higher initial viability consistently had higher viability throughout the tests.

The percent reduction of viability for the two batches was similar over the period of the study (Figures 2 and 4). Seeds stored at 70F showed the greatest reduction of viability. Seeds in the 5/9 batch which had the lowest initial viability had a greater reduction over the period of the study. Reduction in viability is clearly related to the initial concentration of viable cells in the inoculant.

Determinations of the ability of viable Rhizobia to infect and nodulate Lespedeza following storage at the various temperatures and times was not in the scope of this project. However, seeds from the 6/17 batch and the three temperatures after 28 days storage have been planted. The extent of nodule formation will be determined.

Figure 1. Viable Rhizobia cells from inoculated Lespedeza seed after 0, 3, 7, 14, and 28 days storage at 40, 60, and 70 F. Sample dated 5/9/82.

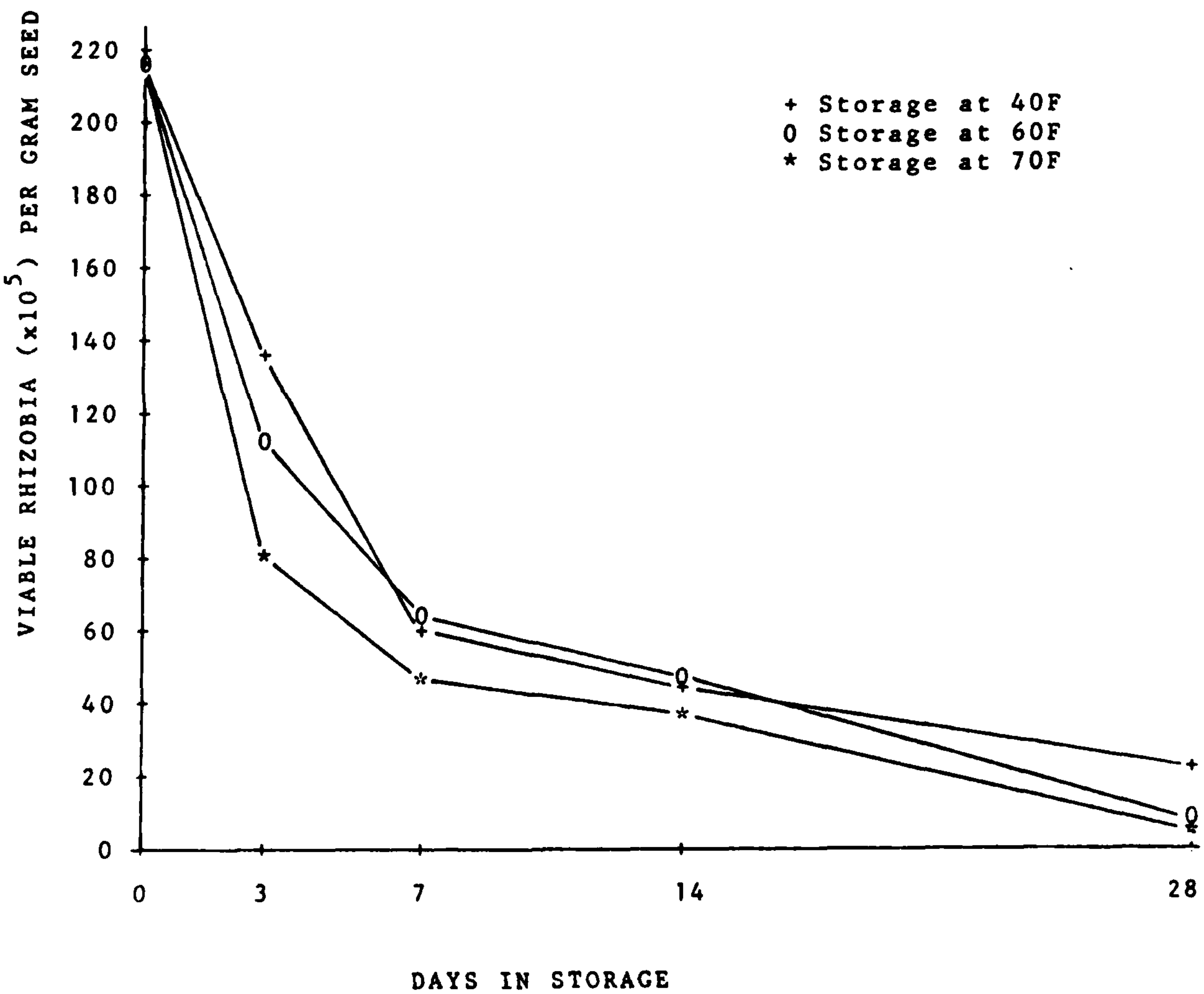

Figure 2. Percent viable Rhizobia cells from inoculated Lespedeza seed after 0, 3, 7, 14, and 28 days storage at 40, 60, and 70 F. Sample dated 5/9/82.

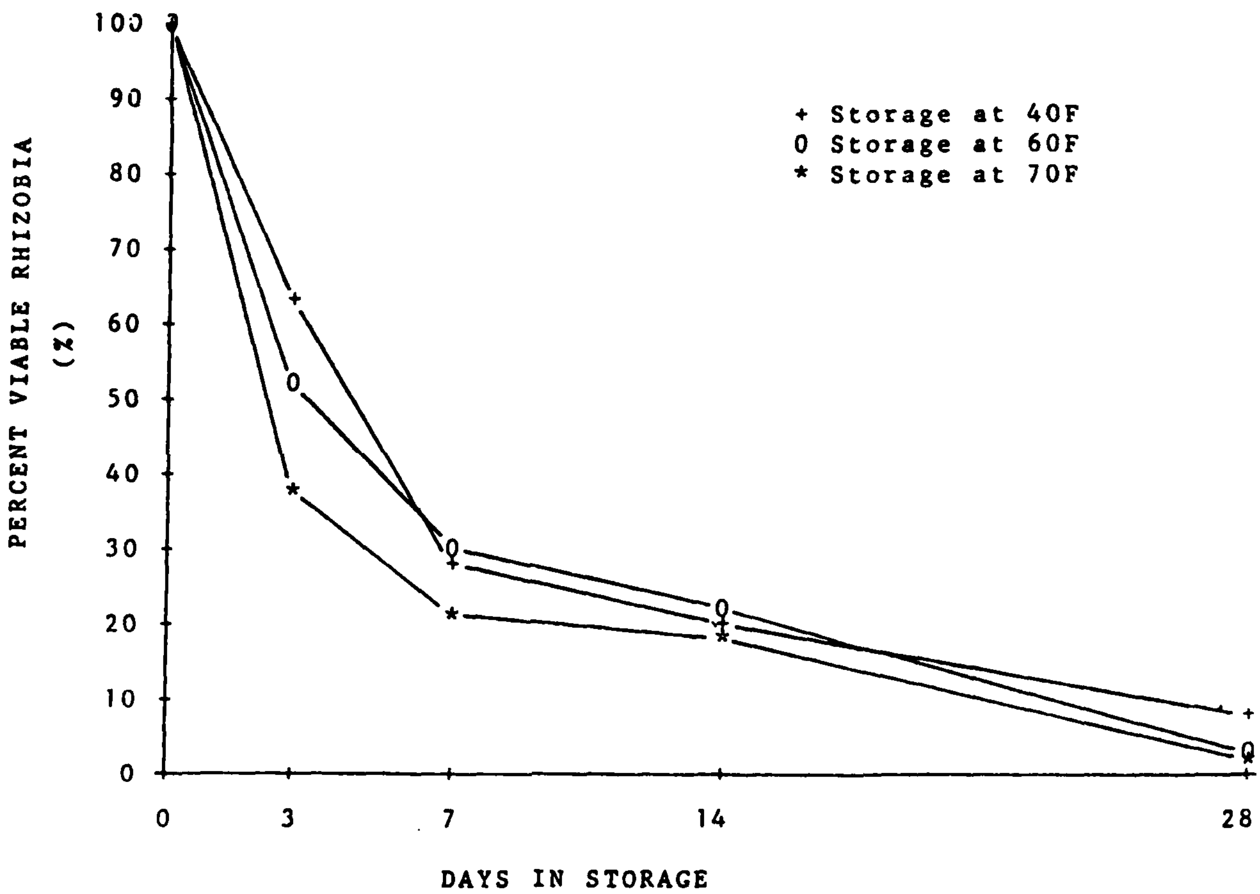

Figure 3. Viable Rhizobia cells from inoculated Lespedeza seed after 0, 3, 7, 14, and 28 days storage at 40, 60, and 70 F, Sample dated 6/17/82.

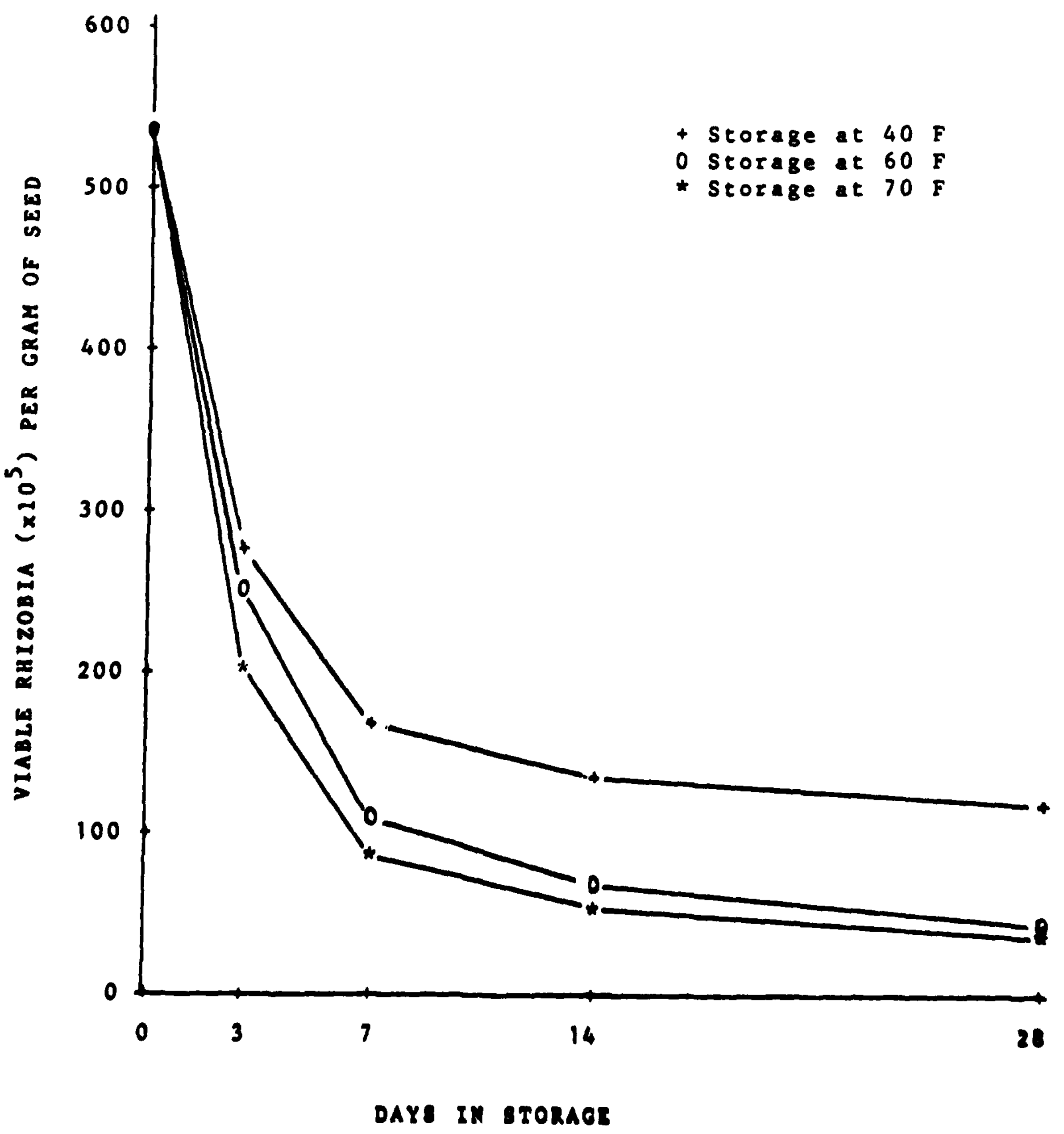

Figure 4. Percent viable Rhizobia cells from inoculated Lespedeza seed after 0, 3, 7, 14, and 28 days storage at 40, 60, and 70 F. Sample dated 6/17/82.